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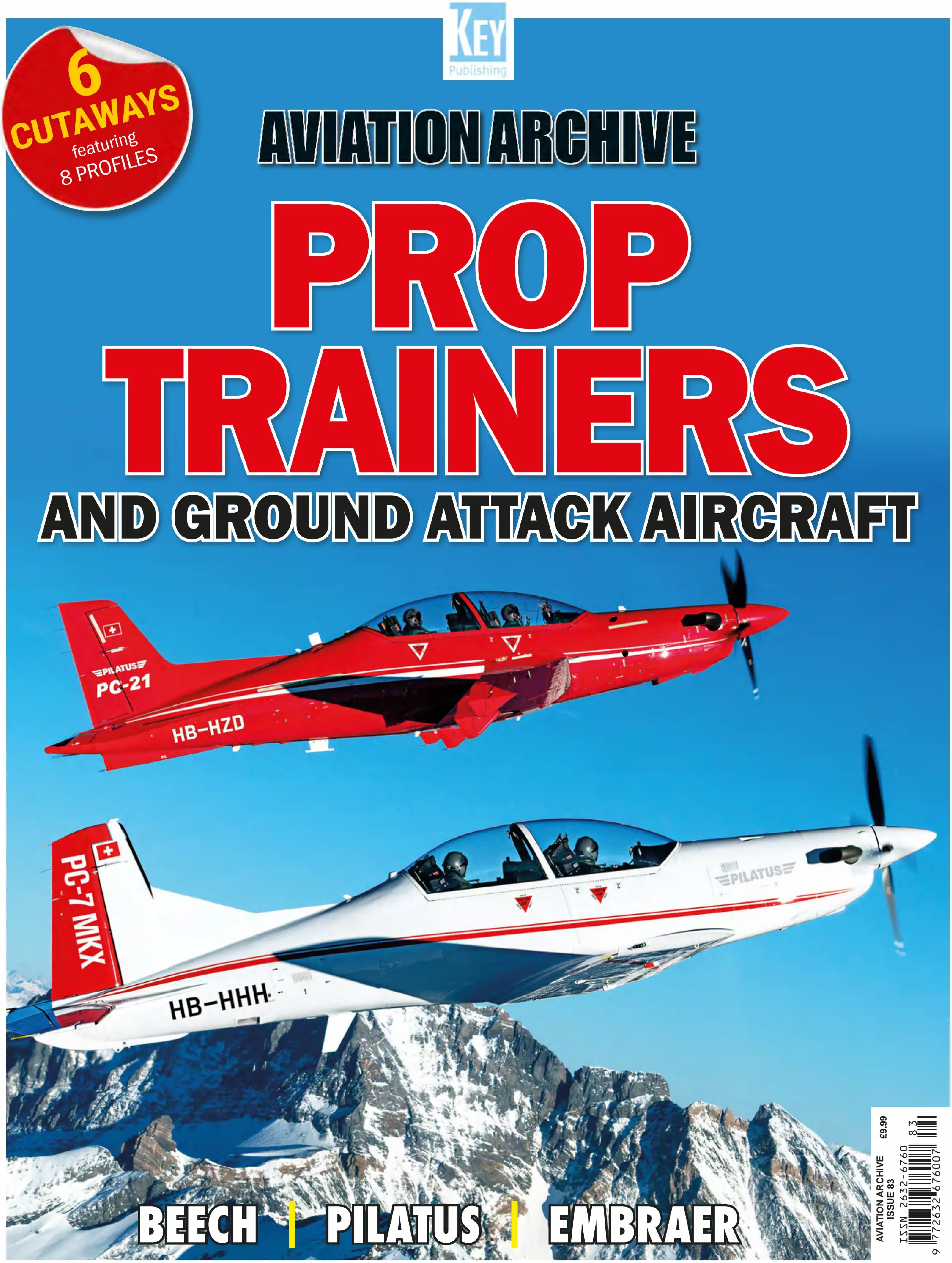
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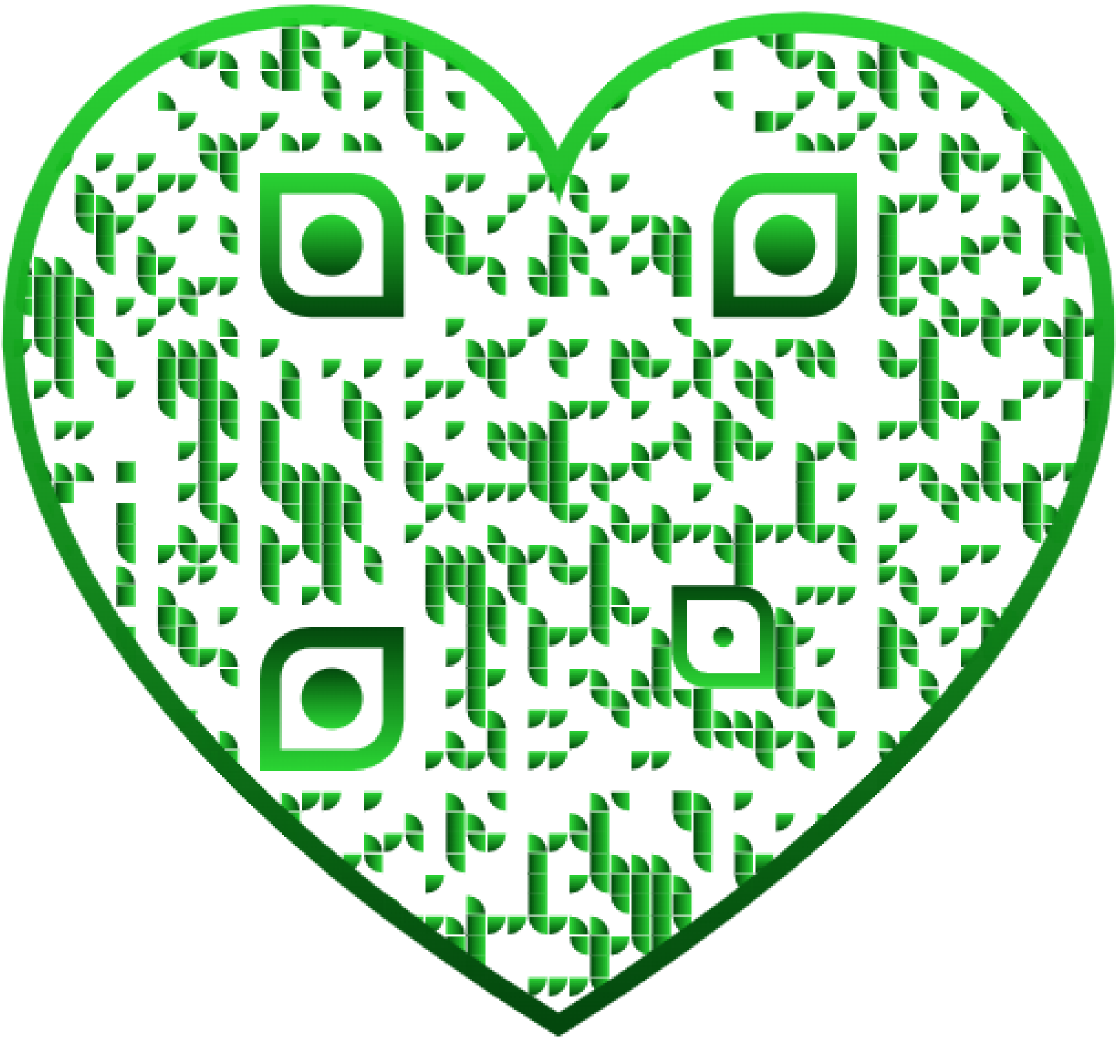

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The venerable T-6 Texan continues to give instruction and pleasure to aviators 90 years after the type's first flight. Jim Winchester

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The Pilatus PC-21 and PC-7 can trace their lineage to the P-3 of 1953 and are both selling in today's competitive trainer market. Pilatus

Through Hardships to the Stars

This issue complements Aviation Archive 70, which covered jet trainers and those ground attack aircraft derived from them. Again it doesn't cover every single type, but includes those of the World War Two era that had significant post-war careers and later aircraft that were technically interesting and/or sold well . Today the upper end of the trainer market includes a half-dozen or so tandem-seat turboprops of essentially identical configuration, powered by variations of the same PT6 engine. The distinction for the prospective purchaser comes down to the total package price including support and ground-based training systems and what weapons capability it has, if such is desired. Some modern light prrop-driven combat aircraft can carry firepower greater than that of earlier bombers, and sensors that rival dedicated reconnaissance platforms. Even the light piston-engined training aircraft now feature sophisticated navigation, communications and systems management suites to prepare trainees for the cockpits of the frontline aircraft they aspire to fly.

For this issue David Willis has written the entries for the Stearman, Tiger Moth, Prentice, Balliol and Bulldog and again has helped greatly with picture research.

The profile illustrations are by Rolando Ugolini , except the Winjeel and Pilatus P-3 which are Pete West/Key, and design is by Paul Sander. Uncredited images in this edition come from the Key Archive and others are only individually credited if sourced from elsewhere.

Jim Winchester

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Attack Helicopters

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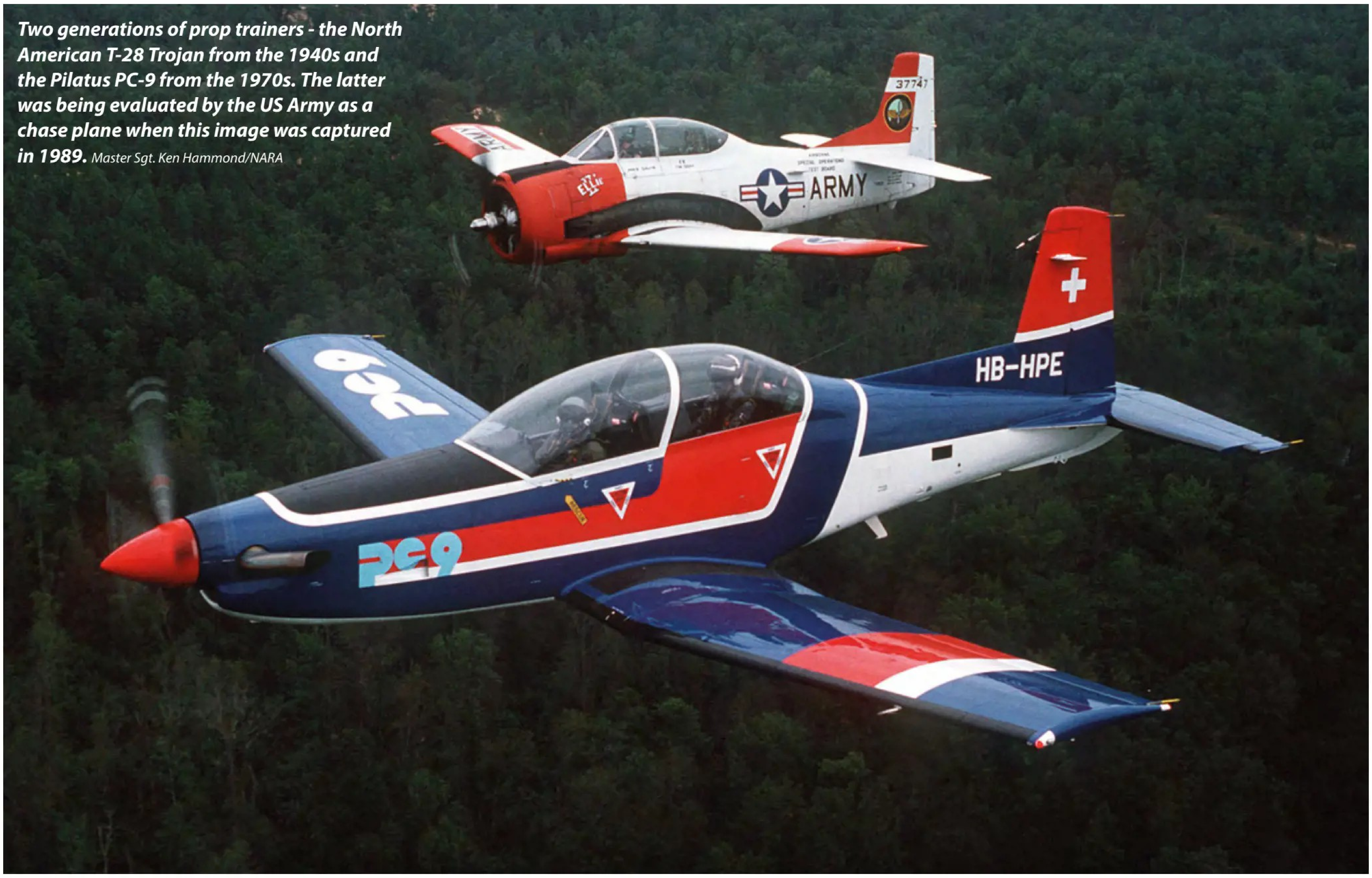


Two generations of prop trainers - the North American T-28 Trojan from the 1940s and the Pilatus PC-9 from the 1970s. The latter was being evaluated by the US Army as a chase plane when this image was captured in 1989. *Master Sgt. Ken Hammond/NARA*

Introduction

Pilot Makers

Prospective military aviators have to put up with various nicknames: 'Penguins' (because they can't fly); 'Nuggets' (because they are raw material that needs work to shine); 'Studs' (pronounced 'Studes') or ''Boggies' (short for 'Bograts', don't ask).

Despite their dreams of becoming the next 'Top Gun', many students will fall at various hurdles along the way before they ever get in the cockpit of a high performance fighter or helicopter or heavy transport aircraft. So, those basic, intermediate and advanced trainers may be all some officers get to fly and as it is not in the interests of the air arms of the world to train lots of pilots to fly and then reject them, training aircraft need to be as efficient and safe as possible, but not without providing challenges for the student.

Customers for a trainer aircraft have to decide between side-by-side or tandem seating, each of which has its advantages and disadvantages for instruction and learning. An argument for tandem seats is that it more closely replicates the pilot's location in a single-seat or twin-seat fighter. A narrow cockpit gives a better view to the sides and reduces drag, allowing better performance for a given engine power. The controls can be duplicated in the rear cockpit including a HUD repeater on a display screen, although this is not always used as it displaces other information such as a map. Instructors in tandem aircraft learn to teach using voice and jiggles on the controls to confirm understanding. A raked cockpit with the rear seat raised higher than the front can help overcome the limited forward vision of the instructor.

Seating the instructor and student facing the same panel has the advantage that the former can point to instruments or landmarks and can observe the latter's handling of switches and controls, arguably fostering better communication between teacher and pupil.

For an air arm such as the Japanese Maritime Self Defense Force, the side-by-side arrangement as used on their Fuji T-5s makes the best sense as JMSDF students will go on to fly helicopters or multi-engined aircraft. The Air Defense Force (JASDF) streams fast jet pilots from the tandem Fuji T-7 onto the Kawasaki T-4 and then the two-seat Mitsubishi F-2 or F-15DJ Eagle. F-35 pilots have a steeper transition to the front line as there is no 'twin stick' version and must rely more on simulators.

Not so long ago, military cockpits were designed for the 'average' adult male, with canopies that sometimes barely cleared a hard helmet. Ejection seats, if fitted at all, only worked above take-off speed, and their propellant cartridges or rockets were likely to inflict serious injury on pilots of smaller stature. Between the introduction of the Pilatus PC-9 and its selection as the basic trainer for all US military pilots, attitudes had changed. The design had to be modified to accommodate a much wider range of weights and heights, from the 5th percentile female to the 95th percentile male. Seats had to

The occupants of trainer aircraft are not all instructors and students : Flt Lt Belinda Pavlovic was a flight test engineer with the RAAF's Aircraft Research and Development Unit (ARDU). Cpl Craig Barrett/RAAF

ensure safe egress from a stopped aircraft on the ground (zero knots and zero airspeed) without causing back or other injuries. Stricter birdstrike requirements for higher speeds at low level brought about a redesign of the PC-9's canopy to add windscreen capable of deflecting the impact of a goose-sized bird at up to 270 knots (310mph, 500km/h).

The trend these days is for primary training aircraft, such as the Grob G120, to be side-by-side, while advanced trainers are tandem-seaters like the T-6 or PC-21. The latter are more adaptable to other missions such as light attack, interception and patrol, which can be a decisive factor for an air force trying to reduce the number of basic types in its inventory to achieve cost savings.

Development and production of propeller-driven trainers is within the means of many less-wealthy nations, which can fulfil some of the training needs of its air force without spending large amounts of foreign currency. Countries such as Chile, Finland, New Zealand, and Romania have maintained their aerospace sectors by producing trainers for domestic use and for export customers. Large aerospace concerns in Brazil, Turkey, India and South Korea found their feet with prop trainers,

The fundamental question of prop versus jet for what the UK calls ab initio (from the beginning) and the US calls undergraduate pilot training (UPT) has largely been answered.

An instructor pilot and student naval aviator have a last minute briefing before a sortie in a T-34C of VT-28 at NAS Corpus Christi, Texas. Richard Stewart/US Navy

G-ETPC
QINETIQ
QINETIQ

Modern trainer design philosophies are illustrated by this Grob G120 leading a Pilatus PC-21. Both aircraft are highly capable flying training platforms, acquired by ETPS in 2017 and 2016 respectivel. *QinetiQ*

The USAF went to an all-jet training pipeline in the early 1960s, replacing the T-34 and T-28 with the Cessna T-37 'Tweet'. They reversed this in 1964, adding the Cessna T-41 (Model 172) Mescalero as a lead-in trainer for jet pilots. These stayed in service until the early 1990s when the British Slingsby Firefly was introduced. Unfortunately, for a variety of reasons related mainly to the aircraft itself and how it was used, this proved a bit of a failure. Now, after Initial Flight Training (IFT) at a civilian-run school, USAF candidates fly the T-6A turboprop as their first service aircraft.

Some prospective aviators prove susceptible to airsickness or don't take to flying at all. Discovering this after ground school and a number of flights in turboprop or jet trainers can be an expensive business that reduces the throughput of pilots to operational units. Elementary Flight Screening (EFS) Gives candidates a taste of flying at relatively low cost. Some will discover that flying is not for them but want to continue service careers in other fields. Some of the smaller air forces conduct flight screening on ultralight aircraft, which cost very little to run, but have little in common with purpose-built military trainers.

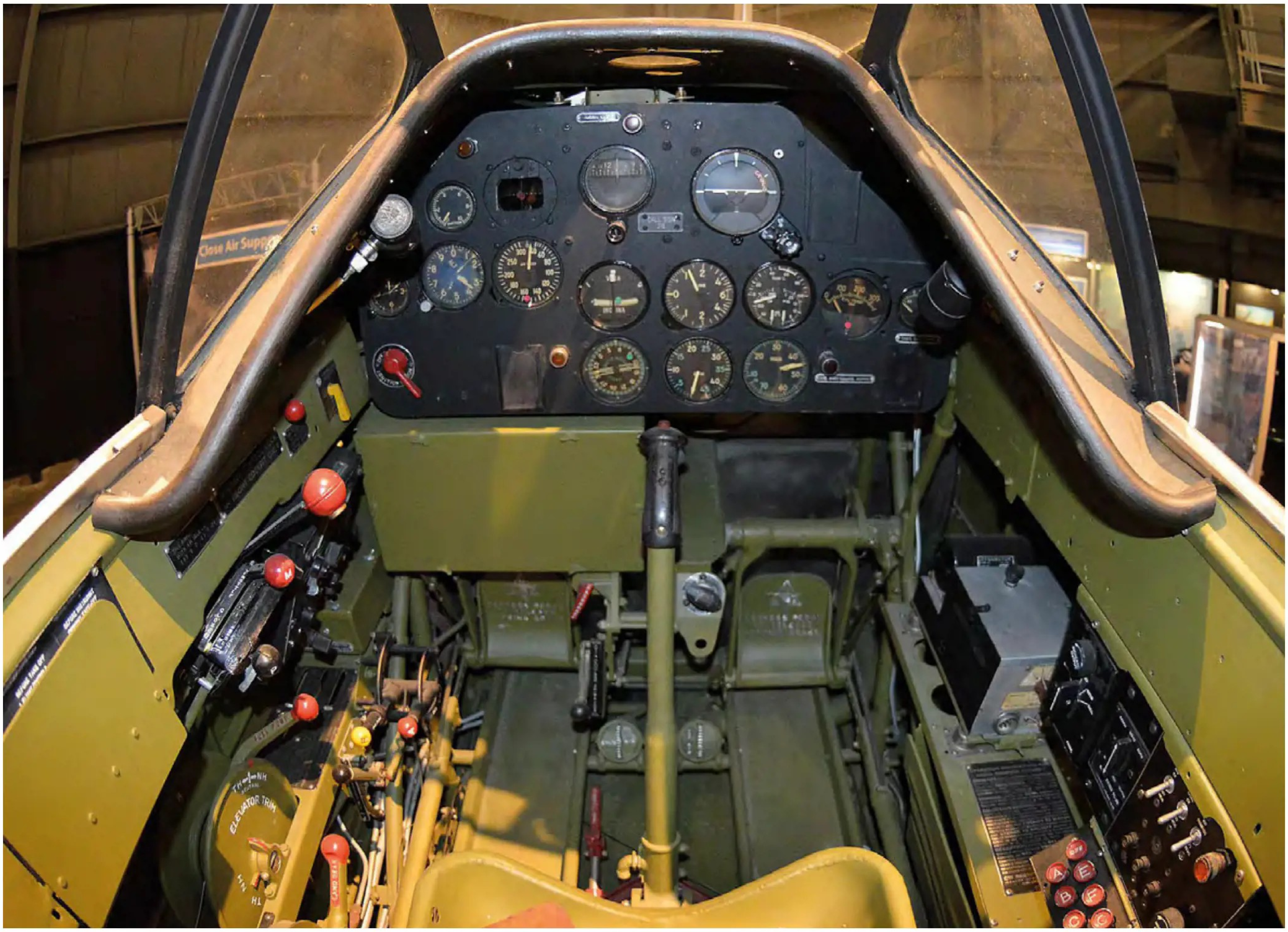
With 50 per cent of students 'washing out' at the initial jet phase and high fuel prices in the 1970s, France introduced the Mudry CAP.10 light aerobatic plane as a screening aircraft to reduce use of the Fouga Magister. Once passing that phase, they moved on to the SOCATA Epsilon. The Epsilon course lasted 70 hours in 72 flights, comprising familiarisation (10hr), advanced manoeuvring (14hr), blind flying (12hr), night navigation (8hr), IFR navigation (6hr), Night flying (8hr) and formation flying (12hr). Of this total, just over 7hr was solo in nine sorties.

Each air arm has its own syllabus and the example above is just one way to do it. Some 'front-load' training tasks such as tactical flying onto the advanced prop courses to reduce the wash-out rate at later training phases or the operational conversion units. Whatever the pathway and how many flying and classroom hours it takes to win the gold wings or brevet of a military aviator, every graduating pilot will say it was worth the effort.

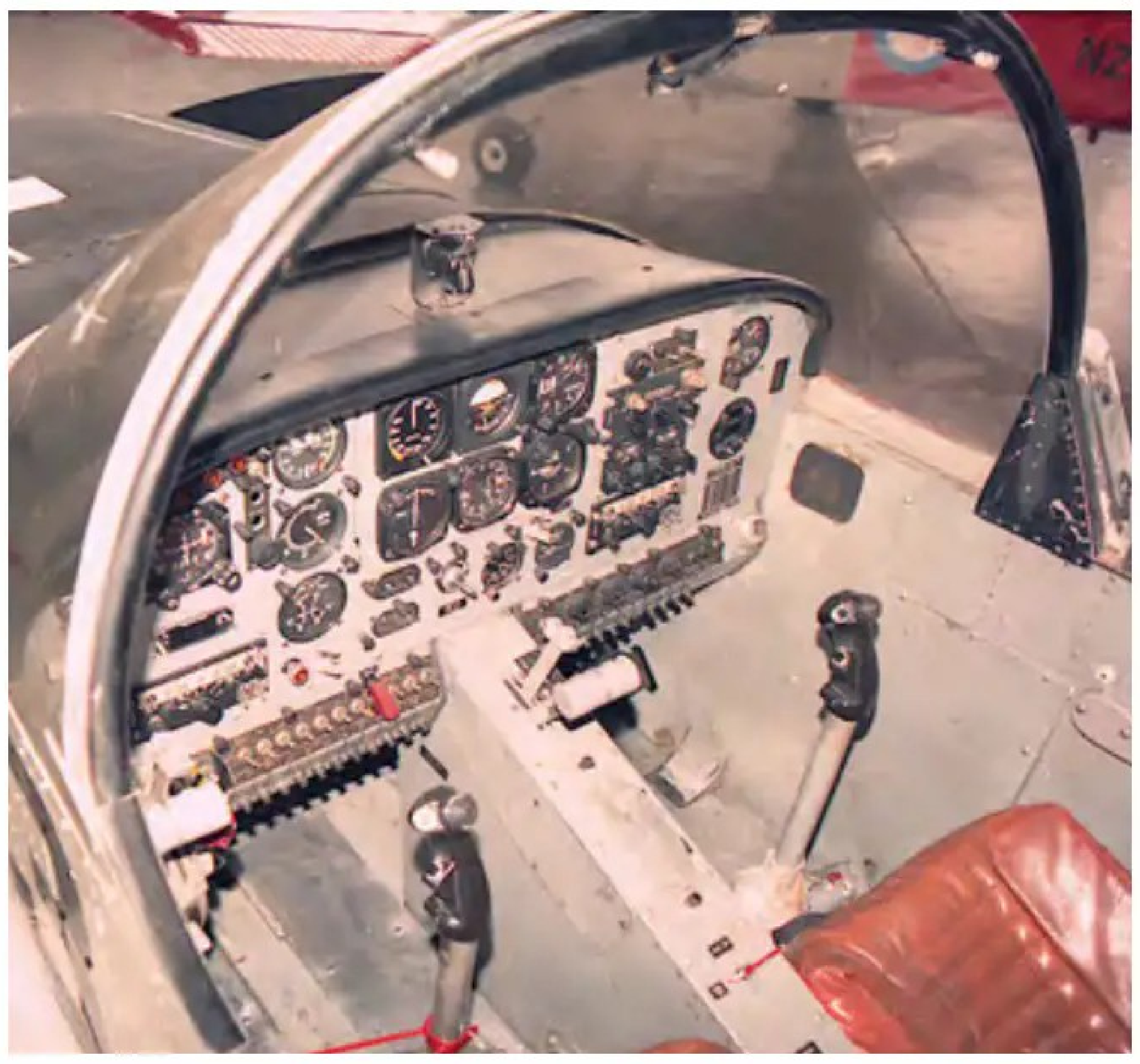
With limited budgets, some air forces conduct all training to 'Wings' standard on turboprops such as the Texan II or PC-9. Depending on their eventual frontline type, the student may move on to a light helicopter or small twin such as the Beech King Air with a dual training and operational role. With increased use of simulation and synthetic training, this stage may even be dropped in the future, with the single-engined prop trainer taking him or her from first flight to the cockpit of a medium helicopter or heavy transport aircraft. ■

Joint Terminal Attack Controller (JTAC) training is another mission for training aircraft types. The RAAF is looking for a replacement for its PC-21s in this role able to employ live weapons. *Sgt Shane Gidall/RAAF*

Prop Trainer Cockpits



The LT-6G Texan's instrument panel was a simpler version of a World War Two fighter's. The later T-28 would mimic the instrumentation in the F-86 Sabre jet. NMUSAF



The RNZAF CT/4B Airtrainer's instrument layout was modelled on that of the BAC Strikemaster Mk. 88, which the student would progress to after the basic flying stage. Jim Winchester

The early KAI KT-1 Woong Be trainers had a mix of conventional instruments and small LCD screens. The KA-1 attack variant has three large multi-function displays (MFDs) Jim Winchester

Modern trainers such as the Pilatus PC-21 have replaced almost all mechanical instruments with large flat-screen displays that can be controlled by buttons on the throttle and stick. Pilatus

The PC-21 was designed to combine both the roles of a primary trainer and a lead-in fighter trainer while providing students with experience of the performance they will encounter once posted to a fast jet unit.

Aldo Wicki/Pilatus

Tiger Moth BB604 was in use with 21 EFTS at Booker, Buckinghamshire from 1948-1950 before becoming an instructional airframe with an ATC squadron in Surrey. David Willis collection

De Havilland DH.82A Tiger Moth

The Postwar Career of the Wartime Trainer

While the heyday of the Tiger Moth as a pilot trainer was during World War Two, considerable numbers remained in service with the RAF after the conflict. Many other air forces only received the aircraft post war.

The RAF used the Tiger Moth as an elementary trainer role for 17 years. Although rapidly replaced by new, monoplane trainers after the end of the war, as demand for new pilots declined, the large numbers available meant that when the RAF needed to expand its training capabilities they were assigned to new units.

From March 1947, 25 Reserve Flying Schools (RFS) were established with Tiger Moths so that wartime RAF pilots could retain their flying skills. They were also assigned to 18 University Air Squadrons (UAS). It was not until February 1955 that the last examples were retired by the RFSs and UASs, after being replaced by de Havilland Canada Chipmunk T.10s.

Just over 100 Tiger Moths also served with the Fleet Air Arm after the war, operated by numerous communications and training units. No.727 Squadron at RNAS Gosport, Hampshire, continued to fly Tiger Moths to train non-flying sub-lieutenants and Royal Marine officers until it disbanded in January 1950. Royal Navy Tiger Moths flew from Roborough, Dorset, for the Royal Navy Engineering College and Britannia Royal Navy College, providing air experience and on glider-towing duties for cadets at Dartmouth. Again, they were replaced by Chipmunks, in June 1966. The Navy's last Tiger Moths, operated by 781 Squadron, were retired in March 1972.

Tiger Moths in 1945 at Perth Scone, some of which have lost their wartime camouflage. N6586 in the foreground was stored in 1947 and sold for spares in 1953. Jim Winchester collection

Postwar Tiger Moths continued to be operated by the air forces that participated in the Empire Air Training Scheme, although in smaller number than the large wartime fleets. Canada operated more than 1,500 Tiger Moths, most built in the country, but the type was retired in 1948. Likewise, Australia had just under 900 aircraft, 732 of which were assembled locally, of which some 540 were civilianized postwar, others serving as the Royal Australian

DH.82A Tiger Moths lined up alongside DH.104 Devons at RNZAF Wigram in 1955. The two nearest aircraft were New Zealand-built and are both airworthy today. *Air Force Museum of New Zealand*

Air Force's primary trainer into the 1950s. Its last examples were withdrawn in January 1957, although the Royal Australian Navy retained three into the following year.

A total of 320 Tiger Moths served with the Royal New Zealand Air Force during the war, including aircraft built in the UK and in-country, as well as impressments. In April 1946 New Zealand still had 216 Tiger Moths, many of which were stored, the inventory decreasing to 146 one year later and 99 in April 1948. By April 1950 just 40 were in service, falling to around 30 by mid-1955. The aircraft was retired in 1956.

Tiger Moths served with the Rhodesian Air Training Group throughout the war, but in 1947 the Southern Rhodesian Air Force received two, following by ten more in the next two years and then six in February 1952. They remained in service into 1955.

Former RAF Tiger Moths were also transferred to several European nations postwar, so they could re-establish a flying training syllabus. Belgium received 31 from November 1946, which served primarily at Schaffen. The survivors remained in service into 1956. Around 200 Tiger Moths were supplied to France in the immediate post-war years. They were replaced by Stampe SV.4s as they became available, although some were still in use in 1952.

A total of 36 RAF Tiger Moths went to the Netherlands in July-August 1946, plus a further 20 from the same source in February 1947, including the very last built. They served with the Elementary Flying School (EVO) at Woensdrecht, although several were later loaned to government flying clubs and at least four were flown by the Netherlands Naval Aviation Service (MLD). The EVO replaced its Tigers with Fokker S.11s between 1950 and 1952, but the last with the MLD was flown until July 1962.

A total of 17 were delivered to the Royal Hellenic Air Force in 1947, which were used as the service's basic trainer until 1955. OGMA built 91 Tiger Moths in Portugal, while a small number were supplied from the UK during the war. Around 39 remained in service in May 1952, when the army and naval air arms merged to create the air force, although they were retired the following year. Other postwar European nations with Tiger Moths were Czechoslovakia, which had one, and Sweden, which continued to use some of the 36 (as the Sk 11/As) acquired pre-war. The 2nd Training Aviation Regiment of the Yugoslavia Air Force operated 24 from the end of the war until retired in 1948.

Tiger Moths were also flown by nations after they gained their independence from the British Empire. Around 100 Tiger Moths were reconditioned at Bangalore for its air force after Indian became independent in November 1947. They served as trainers at Begumpet and Jodhpur, while some flew with the Artillery School at Deolali into the 1950s. After the HAL HT-2 entered service, the Tigers passed to 51 (Delhi) and 52 (Bombay) Squadrons of the Auxiliary Air Force at Safdarjang and Juhu. India retired its Tiger Moth from the training role in 1957.

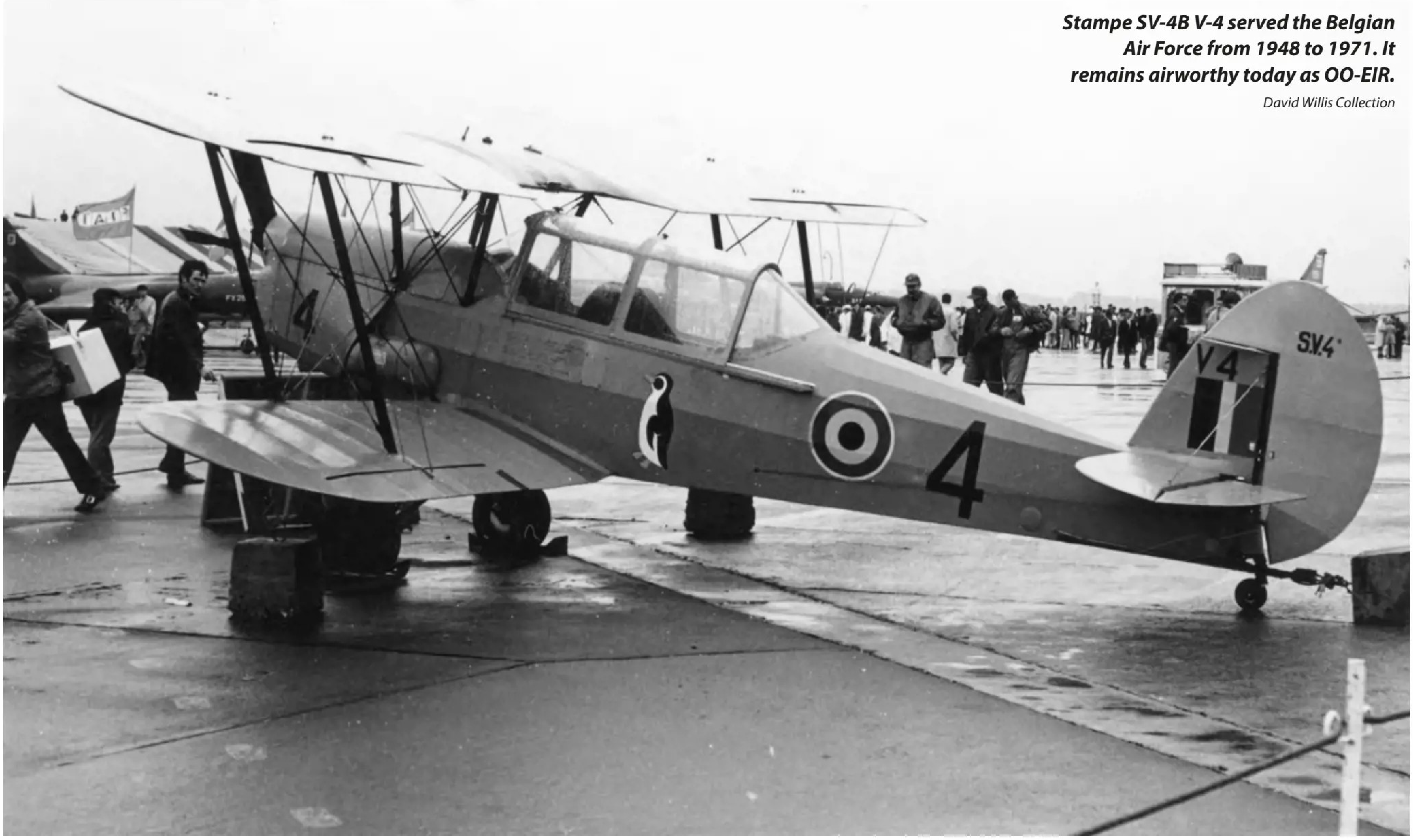
Similarly, Pakistan put the Tiger Moth into service following independence. Ten aircraft were used at Risalpur, remaining in service into 1955. From October 1950 the Malayan Auxiliary Air Force trained on Tiger Moths, but they were replaced by Chipmunks when the country became independent at the end of August 1957. The Union of Burma Air Force also had Tiger Moths upon its formation in January 1948.

In 1950 the Royal Thai Navy placed an order for Tiger Moths from Rollasons, which offered surplus RAF aircraft on the commercial market. At least 31 – and possible 37 – were delivered, but the June 1951 coupe by the Navy meant they went to the Royal Thai Air Force as B.F10s. They were retired in 1961.

Other nations that flew Tiger Moths included the Arab Legion Air Force (two), Israel (two with A Squadron at Sde Dov in May 1948) and Saudi Arabia, the latter receiving examples via a British military mission circa 1950. In South America Uruguay had 18, but retired the biplanes in 1949. ■

de Havilland DH.82A Tiger Moth II

Crew: Two
Length: 23ft 11in (7.29m)
Wingspan: 29ft 4in (8.94m)
Height: 8ft 10in (2.68m)
Empty weight: 1,115lb (506kg)
Max T/O weight: 1,770lb (803kg)
Powerplant: One de Havilland Gipsy Major piston engine, rated at 130hp (97kW)
Max speed: 109mph (175km/h)
Service ceiling: 13,600ft (4,145m)
Range: 302 miles (486km)
Armament: None



Stampe SV-4B V-4 served the Belgian Air Force from 1948 to 1971. It remains airworthy today as OO-EIR.

David Willis Collection

Stampe et Vertongen SV.4

Belgian Tiger

The Stampe biplane trainer had a complicated production history interrupted by World War Two. Afterwards it became the basic trainer for Belgium and France and a popular sport aircraft.

Renard, Stampe & Vertongen (RSV) built several light aircraft in the 1920s and were also the Belgian agents for de Havilland. In 1933 Alfred Renard left to form his own company

While Jean Stampe and Russian George Ivanov stayed to design an aircraft with a striking resemblance to the DH.82A Tiger Moth. This was the SV.4, commonly called the Stampe, and OO-ANI first flew on 17 May 1933 in the hands of Monsieur Stampe himself. Latvia ordered ten and began license production as the SV.5. With modified wings, the type became the SV.4B, and there were orders for 300 from both the French and Belgian governments, but production only reached 35 aircraft before the factory at Antwerp was overrun by the Germans in May 1940. Some of these wound up in the Belgian Congo.

A licence had been granted to Société Nationale de Construction Aéronautique de Centre (SNCAC) to construct the SV.4Bs for the Armée de l'Air and Jean Stampe reached the French factory with several incomplete aircraft, but had to go underground after the Germans got there too. When they left in 1944 Stampe completed 12 SV.4Bs for the Armée de l'Air and SNCAN (Nord) built 701 more, all with Renault 4 Pei engines. A further 151 were produced by the Algérien Atelier Industrie de l'Air and Jean Stampe said these were the best-built of all the SV.4s More than 500 Stamps served with Sociéte de la Formation Aéronautique, an air force flying school.

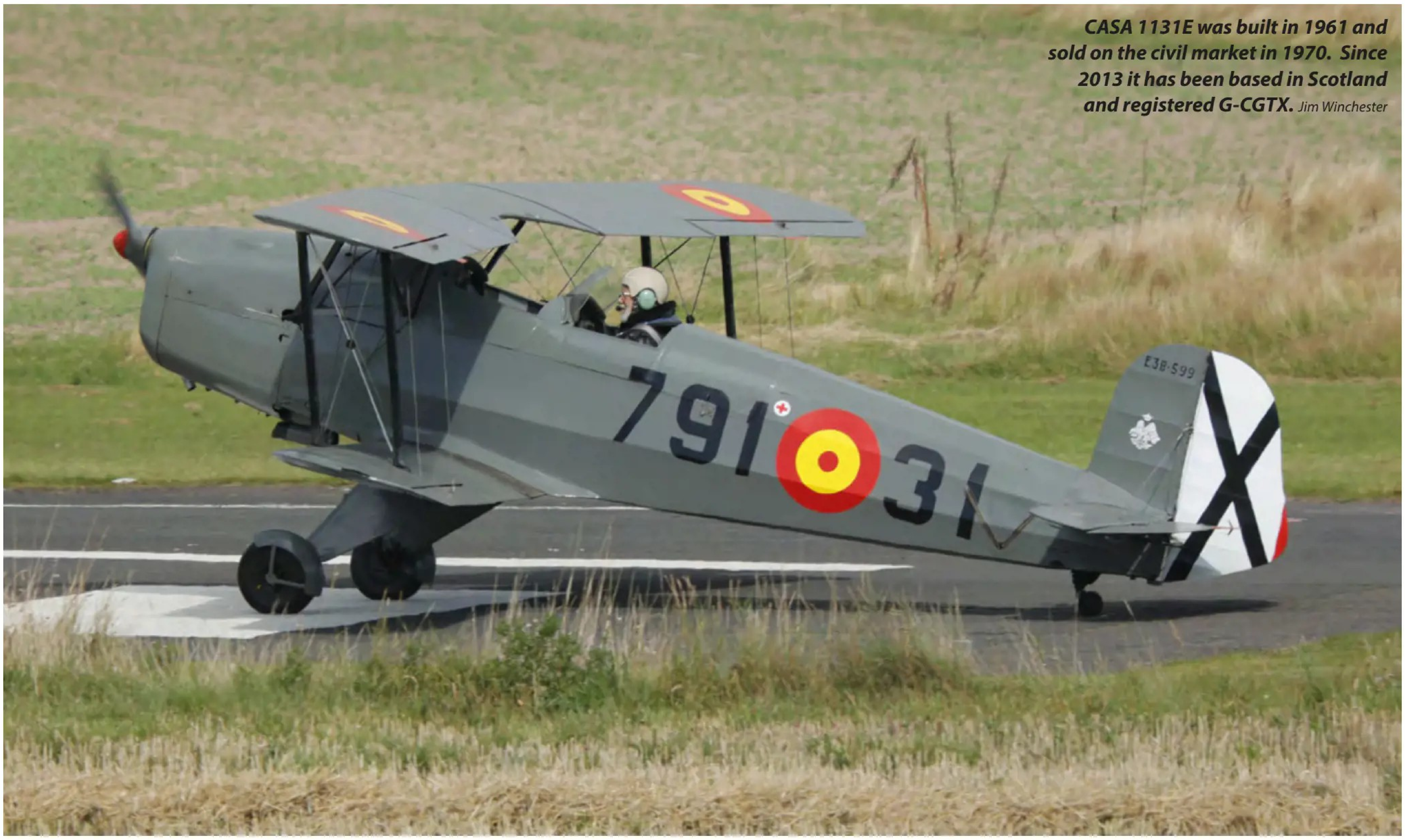
Stampe and his old friend Renard set up Stampe et Renard in Antwerp in 1947, producing the SV.4B with a DH Gipsy Major X engine and an enclosed cockpit,

Evaluated against the Chipmunk T.10, the Gipsy Major-powered SV-4B was chosen as the primary trainer for the Belgian Air Force in the spring of 1947. The first of an initial batch of 33 was delivered to Schaffen-Diest in June 1948. There were several follow-up orders, the first in 1952 with Blackburn Cirrus engines and repeat order in 1953. Finally, eight more with Gipsy Majors were purchased in 1954.

For most of their career the Stamps were based at Goetsenhoven on primary training duties. In 1965 the Manchots (penguins) aerobatic team was formed using two aircraft flown by instructors. The Belgian Air Cadet organisation operated Stampes as glider tugs, until the fleet was retired in 1975. One BAF aircraft was kept in service for display flying until March 1978. Many of the ex-Belgian aircraft remain airworthy in private hands. ■

Stampe et Vertongen SV.4C

Crew: Two
Length: 22ft 10in (6.96m)
Wingspan: 27ft 6in (8.38m)
Height: 9ft 1in (2.77m)
Empty weight: 1,056lb (480kg)
Max T/O weight: 1,716lb (780kg)
Powerplant: One Renault 4 Pei piston engine rated at 140hp (109kW)
Max speed: 112mph (180km/h)
Service ceiling: 20,000ft (6,096m)
Range: 300 miles (480km)
Armament: None



CASA 1131E was built in 1961 and sold on the civil market in 1970. Since 2013 it has been based in Scotland and registered G-CGTX. Jim Winchester

Bücker Jungmann and Jungmeister

Forever Jung

The Bücker aerobatic biplanes have had a remarkable history, seeing more than 30 years of military service and being in and out of production in several countries into the 21st Century.

The first aircraft built by Bücker Flugzeugbau, the Bü 131 Jungmann (young man or freshman/cadet) was built in response to a tender issued by the Reichsluftfahrministerium for a trainer in the 80hp category. Designed by Swede Anders Andersson, the prototype flew on 27 April 1934.

It was a conventional biplane of metal tube and fabric construction with 11-degree wing sweep on both mainplanes, which were interchangeable with ailerons on each panel. It was fully aerobatic and stressed to 12g and proved very successful at interwar flying competitions.

The Jungmann proved very popular as a military trainer and several European nations purchased the type before the outbreak of war, including Bulgaria, Hungary, Greece and Romania. Yugoslavia operated over 400 Bü 131s, Dornier-Werke at Altenrhein in Switzerland produced 87 and Tatra in Czechoslovakia ten as the T 131. Japan built 1,037 under licence as the Kokusai Ki-86A for the Army and 339 for the Navy as the Kyushu K9W. In Germany it was the Luftwaffe's most important primary trainer until mid-war and was also used on night harassment missions over the Eastern Front.

Approximately 100 were supplied to the Spanish Nationalists during the Civi War and from 1938 until at least 1961 a further 530 were built in Spain as the CASA 1.131E with the ENMA Tigre IV engine. The last of the Spanish aircraft was retired in 1968.

In 1946-49 Aero in Czechoslovakia constructed a further 260 C-104s and Polish company SSH revived production in the 1990s, producing T-131Ps with Walter or LOM engines. More than 20 were built for civil customers.

The Bü 133 Jungmeister (young master/champion) flew on 21 August 1935, piloted by Luise Hoffmann. Although 40 per cent of it was common with the Bü-131 It was slightly smaller and while the early series machines were powered by a 135hp (101kW) Hirth Hm6 inline engine, the majority used the 160hp (119kW) Siemens Sh 14a-4 radial. Although a single-seater, it was used for aerobatic and air combat training. In the Luftwaffe it was used to prepare pilots who were destined to fly single-seat fighters.

Dornier built 45 Bü 133Bs for the Swiss Air Force and CASA produced 25 as the ES-1.

In the late 1960s the type was put back into production in Germany as the Bü 133F sport plane, but only around half a dozen were completed. SSH in Poland has also attempted to revive the type. ■

Bücker Bü-131 Jungmann

Crew: Two
Length: 21ft 8in (6.60m)
Wingspan: 24ft 3in (7.40m)
Height: 7ft 5in (2.25m)
Empty weight: 860lb (390kg)
Max T/O weight: 1,499lb (680kg)
Powerplant: One Hirth Hm 504A-2 inline engine rated at 105hp (78kW)
Max speed: 115mph (185km/h)
Service ceiling: 5,600m)
Range: 404mph (650km)
Armament: None

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Now preserved at La Paz, Mexican Air Force Stearman 6089 was one of the last biplanes in military service, used mainly for continuation flying, displays and parades until 2016.

Government of Mexico.

Stearman Kaydet

Boeing Biplanes

The 1930s-era Stearman continued service particularly in Latin America, for many decades after the war, lasting in places into the 1960s, 70s and even in one case the 2010s.

The United Aircraft and Transport Company had owned the Stearman Aircraft Company since 1929 but spun it off as a subsidiary of Boeing in 1934, the same year the Model 75 flew at Wichita, Kansas. Officially the Boeing Kaydet, but usually called the Stearman, the Model 75 was built as the PT-13, -17 and -18, powered by the Lycoming R-680, Continental R-670 and Jacobs R-755, respectively, for the US Army Air Corps/Air Forces, and as the N2S for the US Navy. The biplane was America's primary trainer throughout the war years, after which large numbers were retired and sold on the civil market. Nevertheless, both services continued to operate Stearmans, with the US Air Force retiring its last in 1949, while most of the Navy's had gone the previous year.

Various Stearman models were supplied to Latin American countries both before, during and after the war, many of which continued to fly into the late 1950s. The Argentine Navy originally acquired 16 Model 76Ds in 1936, which served until 1949. They were replaced by Model 75s, delivered in two batches of 30 in 1947 and 1949, the last remaining in service into 1962. Six Argentine aircraft were transferred to Bolivia in April 1958, joining the survivors of 20 PT-17s delivered under Lend-Lease in 1942. Bolivia retired its Stearmans in 1963.

Other Latin American operators included Brazil (30 A76C3s from 1937 and 20 A75s later, retired in 1950); Colombia (60 Lend-Lease PT-17s for its Escuela Militar de Aviación from 1942, withdrawn in 1957, although one was retained for aerobatic displays); Dominica (25 into the 1950s); Honduras (received ten PT-17s in February 1946 and another 12 PT-13s in 1948, flying them until 1963); Paraguay (10 PT-17s supplied circa 1942 under Lend-Lease); Peru (ordered 18 A75N1s in 1941) and Venezuela (four A75L3s from 1940).

Seven A73B1 general purpose biplanes were delivered to Cuba between October 1939 and March 1940, five of which remained operational into 1950. They operated alongside six PT-17s received in July 1942 and three N2S-4s in June 1943, but were replaced by Piper PA-18 Super Cubs acquired in March 1953.

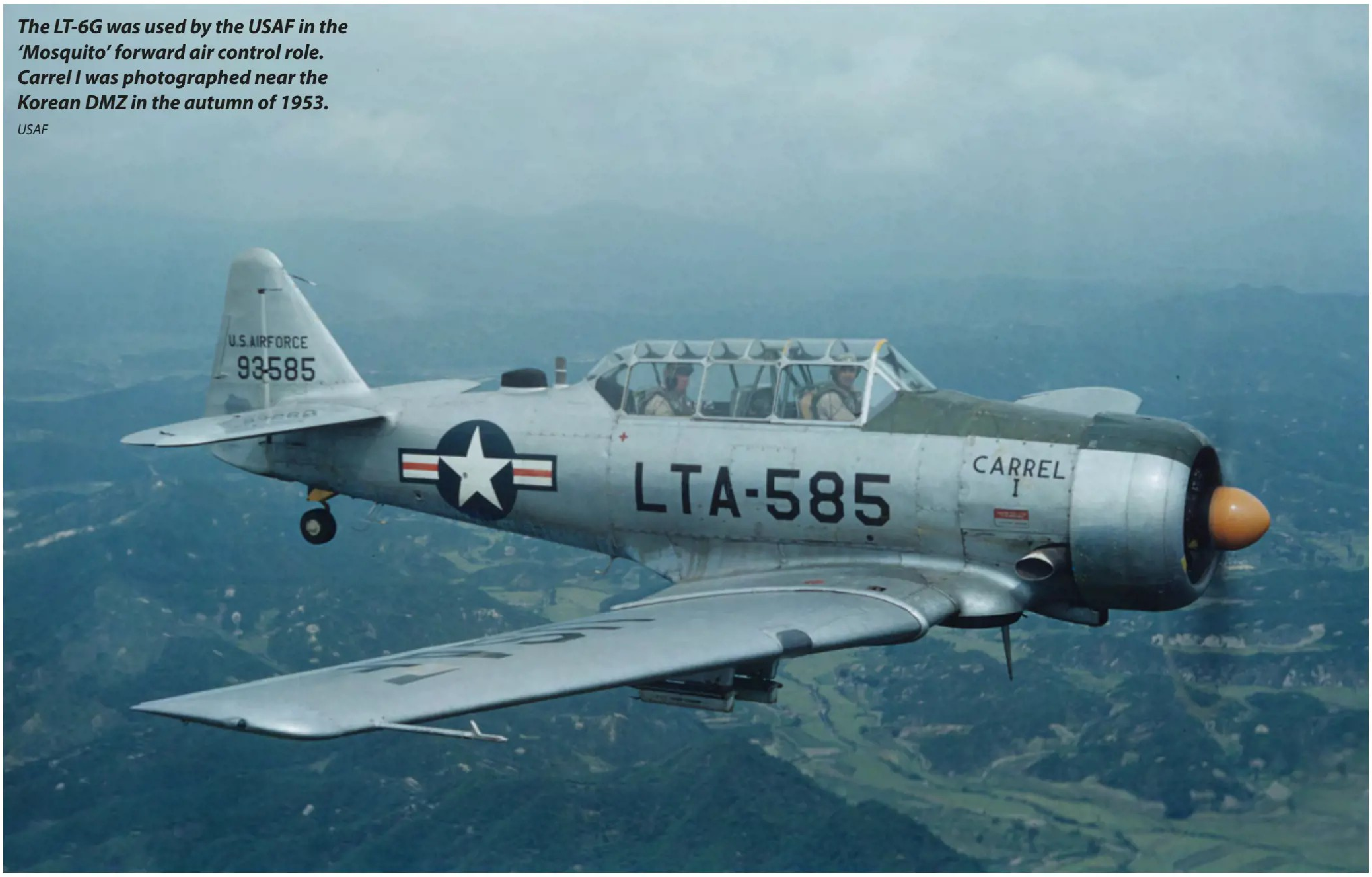
Two Latin American countries had long associations with the Stearman. Guatemala received two in April 1943, with at least one remaining active in 1979. The Mexican Air Force only retired its last examples in August 2016. Around 35 Stearmans were used from 1947, with a dozen rebuilt for the Colegio del Aire in 1967. Six N2S-5s also served with the Mexican Navy from July 1951, two still being operational in 1973.

Outside the Americas, Iran received PT-13s in 1948, which were used into the 1950s, while Greece had around 30 as anti-malaria sprayers between 1945 until 1969. The Chinese Nationalist Air Force received 150 PT-17s under Lend-Lease from 1942, basing them in India during the war. A further 22 were acquired in 1947. An unlicensed copy was also produced as the CJ-1 at the Third Aircraft Factory at Taichung, Taiwan, the first of 104 flying in February 1948. Following the Nationalists retreat to Taiwan in 1949, the aircraft served with the Gangshan Air Force Academy until 1958.

More than 50 PT-13/17s were flown by the Philippine Air Force between 1948 and 1958, initially with the Primary School Squadron at Lipa Air Base. ■

Stearman N2S-5 Kaydet

Crew: Two (one instructor and one student)
Length: 25ft 01/4in (7.63m)
Wingspan: 32ft 2in (9.80m)
Height: 9ft 2in (2.79m)
Empty weight: 1,936lb (878kg)
Max T/O weight: 2,717lb (1,232kg)
Powerplant: One Lycoming R-680-17 piston engine, rated at 220hp (164kW)
Max speed: 124mph (200km/h)
Service ceiling: 11,200ft (3,414m)
Range: 505 miles (813km)
Armament: None



The LT-6G was used by the USAF in the 'Mosquito' forward air control role. Carrel I was photographed near the Korean DMZ in the autumn of 1953. USAF

North American T-6 Texan/Harvard

Pilot Maker to the World

Known to the USAAF and USAF as the T-6 Texan, the USN as the SNJ, and the RAF and Commonwealth as the Harvard, the many aircraft derived from the North American NA-16 served from the 1930s until the 1990s as trainers.

The North American Aviation (NAA) NA-16 was first flown on 1 April 1935 by Eddie Allan. Powered by a Wright R-975-E3 Whirlwind, of 420hp (310kW), it had open cockpits and a fixed undercarriage. With an enclosed cockpit it became the NA-18 or BT-9 Basic Trainer, with the US Navy adopting a higher-powered version as the NJ-1. This in turn led to the BT-14, ordered by French Air Force. Those that were not delivered before the fall of France entered British and Canadian service as the Yale Mk. I.

What would become the T-6 drew heavily on the BT-9 design, but had a retractable undercarriage, more power and an improved wing. It was also influenced by the BC-1, which was a Yale derivative designed as a basic combat trainer with retractable landing gear. It was

An instructor and students at Randolph AFB, Texas in 1948. AT-6D 42-85740 was later loaned to Canada and scrapped in Arizona in 1956. NARA

NZ1037 was one of several RNZAF Harvards used in the FAC role. It is still airworthy today as ZK-ENA. *Air Force Museum of New Zealand*

ordered for the RAF as the Harvard Mk 1.

NAA convinced the US Army Air Corps to buy an armed version as a 'Basic Combat' aircraft, the BC-1, and the Navy ordered its own version as the SNJ-1 scout trainer, featuring the all-metal fuselage of the BT-14, centre wing and undercarriage of the BC-1 and new outer wings. Finally, the BC-1A version for the USAAC was redesignated AT-6 in the Advanced Trainer category, this changed to just T-6 in July 1948.

With a 550hp (410kW) Pratt & Whitney R-1340-47 Wasp radial engine, the AT-6 was the first production training aircraft to have hydraulics, a retractable undercarriage and extendable flaps. Of all-metal construction except for its fabric-covered elevators and rudder, it seated the instructor and student under an elongated canopy with heavy framing. Machine-guns could be fitted under the engine cowl, in the wing and on a rear mount for gunnery training.

During wartime, factories at Dallas, Texas, Inglewood, California, Montreal, Canada turned out more than 14,000 Texans and Harvards for the US services, the British Commonwealth and other allies. Some AT-6B/Cs and Harvard IIAs were completed with wooden rear fuselages to conserve aluminium.

SAAB in Sweden built a total of 136 T-6s as Sk 14s from 1937 to 1946 for the Swedish Air Force. After the war a further 257 Texans were acquired and designated Sk 16s. CAC in Australia built the Wirraway, a version derived from the NA-16, which saw combat in the Pacific in the army cooperation role, and as a trainer until 1959.

The late-war AT-6F/SNJ-6 was the first variant able to carry an external fuel tank. The swivelling rear seat and removable aft canopy section were replaced by fixed units. Armament provisions were deleted and a propeller spinner added to reduce drag. This was sometimes removed as it restricted access to the engine and propeller hub.

In the Korea ground targets were hard to identify by close air support pilots flying at jet speeds. High-winged Stinson L-5 liaison aircraft were used as forward air control (FAC) aircraft to spot targets and direct attacks, but were too slow and vulnerable. The solution was to employ armed LT-6Gs in the 'Mosquito' role. The Texan had poorer downward visibility than the L-5, but could withstand battle damage and carry the heavy radios needed to talk with the ground troops and the 'fast movers'. Launchers for 2.75in rockets allowed the T-6 'Mosquitoes' to mark targets. Groundfire, particularly from 20mm guns was a major hazard and 20 T-6s with 16 aircrew were lost in the first six months of combat in Korea. Many others returned with extensive damage. Missions over enemy territory were prohibited without escorts from F-51s for flak suppression.

Interest in forward air control waned after Korea, the Mosquito squadrons were disbanded and the lessons had to be learned all over again in Vietnam.

The T-6 Remained in USAF service until 1958. Some were assigned to jet squadrons as 'hacks' for liaison, continuation flying and weather observation. Air National Guard units retained the type into the early 1960s.

Almost every nation with an air force operated the T-6, even the USSR, which received 84 AT-6Cs and 'Fs and used them as transition trainers up to about 1950. The Texan saw much combat use in the post-war years. They were often the only aircraft type suitable for counterinsurgency work or were

A single FT-6G was built, with provision for bombs and rockets and although this did not enter production, some of its features were adopted by nations seeking a basic ground attack capability, which was needed during many of the post-war conflicts. In the 1948

Many Latin American nations received T-6s under US mutual aid programmes. Brazilian Air Force AT-6A 1409 was written off in March 1973

The last Harvard in British military service was Noorduyn-built Harvard IIB, KF183, used by the ETPS at Boscombe Down. It accumulated more than 15,000hrs before being sold into civilian hands as G-CORS. Jim Winchester

Israeli War of Independence T-6s were used by both Israel and Syria in combat roles. A Syrian T-6D shot down an Israeli Avia S.199 in July. Texans also in action in the Greek Civil War 1945-49, by Portugal in Portuguese Guinea and Mozambique 1962-74, by Biafra against the Nigerian state in 1968, and Spain in Spanish Morocco and Spanish Gunea 1957-1976.

In the Algerian Civil War (1954-62), no fewer than 30 Armée de l'Air squadrons flew T-6Gs at one time or another against rebel forces, employing gun pods, rockets, light bombs and napalm. Between January 1958 and August 1959, 65 T-6 aircrew were killed and 33 wounded. The type was withdrawn the following year in favour of T-28D Fennecs and AD-4N Skyraiders.

RAF Harvards were operated against communist guerrillas in Malaya from 1948 to 1951, and against Mau-Mau insurgents in Kenya from 1952 to 1960.

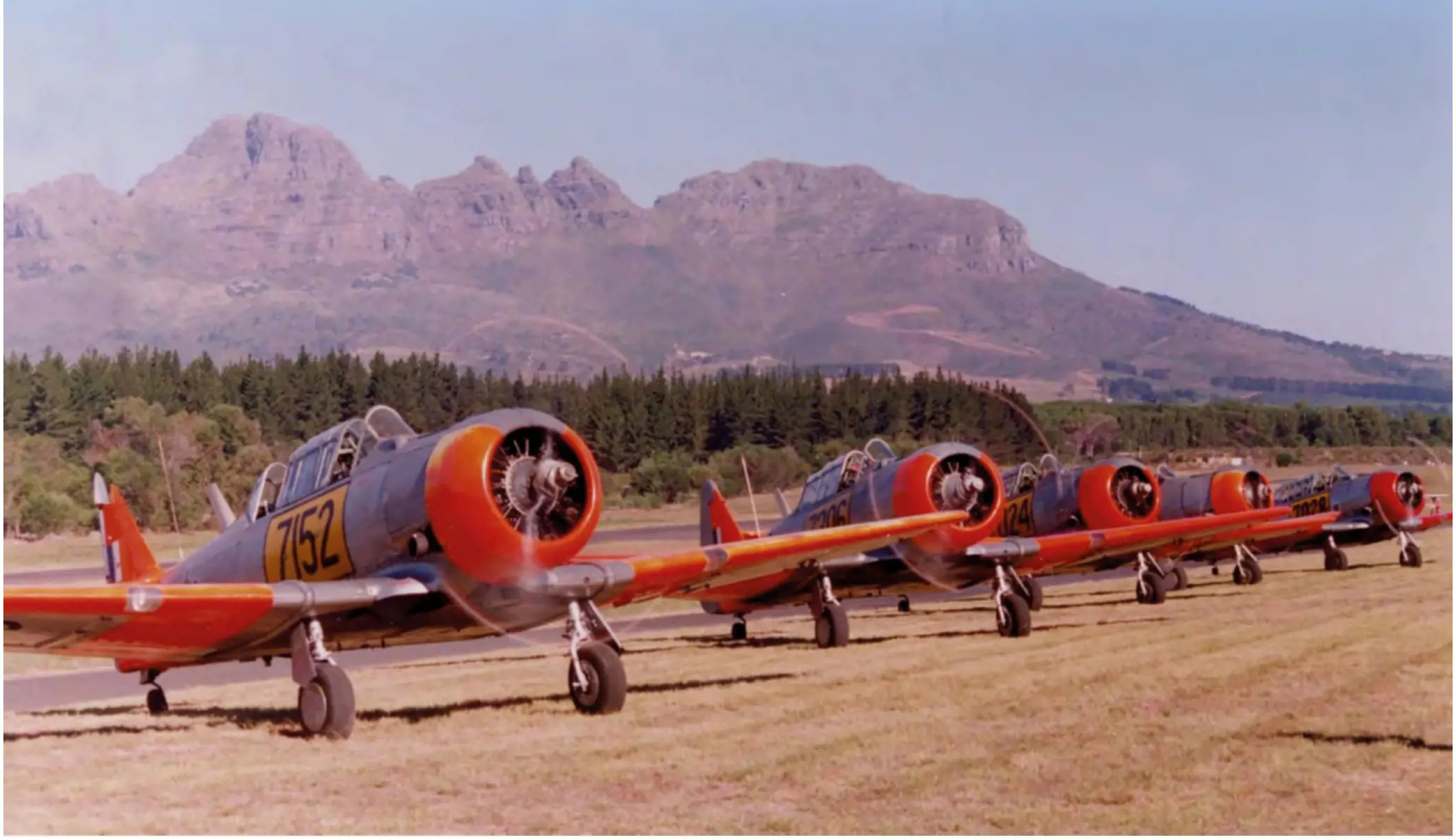
Outside of brushfire wars, the Texan/Harvard's main role continued to be training. The USN used SNJs as primary, basic and instrument trainers, retiring the last from Training Command in 1958. When the NATO Air Training Plan started in 1950, the RCAF required more Harvards. Canadian Car and Foundry at Fort William had bought the licence and began production of 270 Harvard Mk 4s (T-6Js). These were the last new T-6s produced, as opposed to rebuilds, bringing T-6/Harvard production to 15,495. RCAF Auxiliary (reserve) squadrons were all issued Harvards as trainers and refresher aircraft. The last RCAF T-6J was retired in 1968. The last 18 of New Zealand's 202 Harvards were retired in 1977.

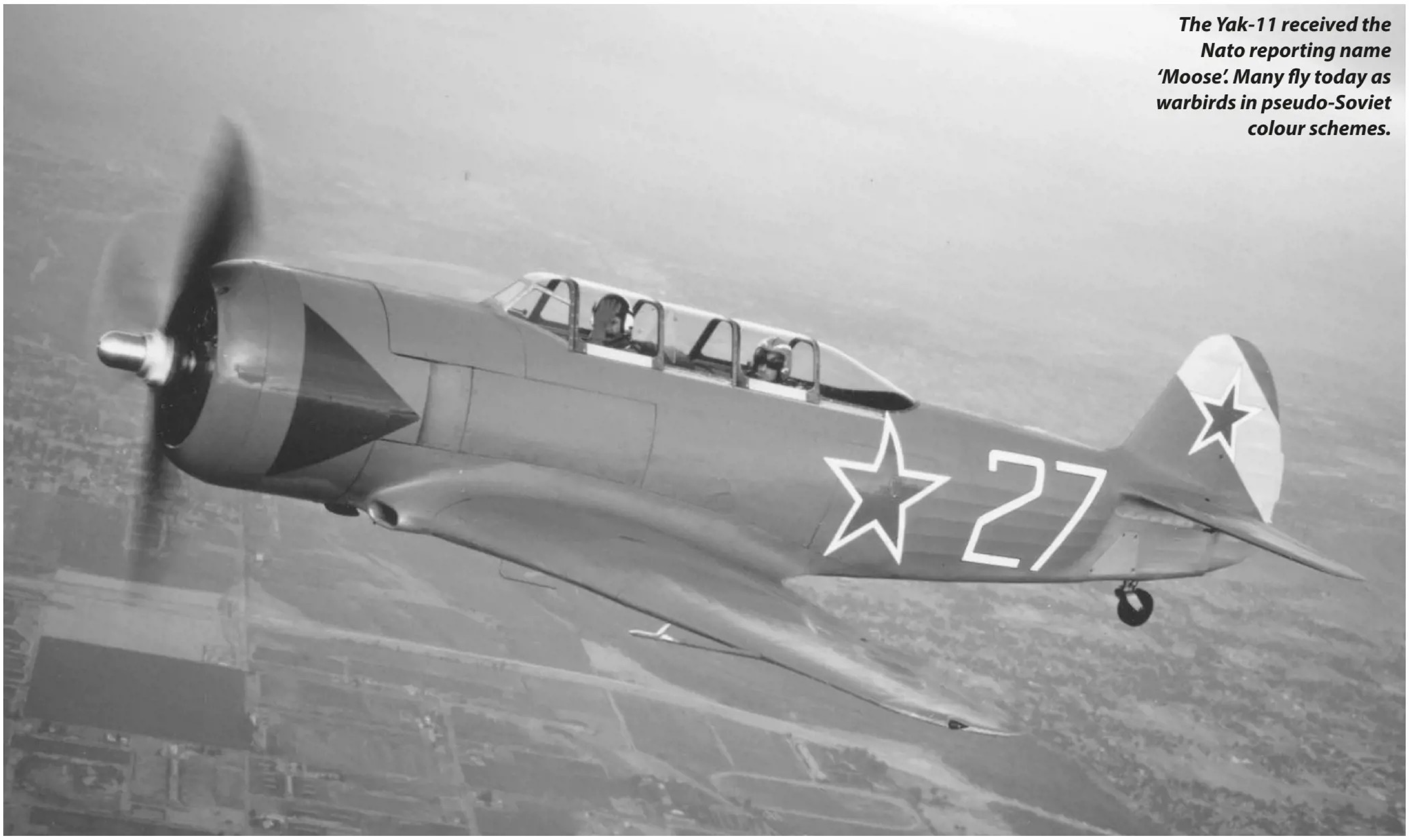
RAF Harvards were retired from training duties by 1958, but others served on, mostly used by test establishments, The T-6/Harvard could open its canopy throughout its speed range, making it ideal for photographic chase missions in support of experimental programmes. Harvard II KF183 served from 1944-2016, probably the longest use of any operational (as opposed to heritage) military aircraft. ■

NAA T-6 (Harvard Mk. IV)

Crew: Two
Length: 28ft 11in (8.8m)
Wingspan: 42ft (12.81m)
Height: : 1ft 9in (3.55m)
Empty weight: 3,995lb (1,814kg)
Max T/O weight: 5,235lb (2,376kg)
Powerplant: One Pratt & Whitney R-1340-AN-1 Wasp radial engine rated at 600hp (448kW)
Max speed: 180 mph (290km/h)
Service ceiling: 22,400ft (6,827m)
Range: 750 miles (1,207km)
Armament: None

South Africa was the last major user of the T-6. Harvard IIA 7152 in the foreground became ZU-AOS in 1992 with the Harvard Club, but was damaged in a 2005 forced landing on a golf course.





The Yak-11 received the Nato reporting name 'Moose'. Many fly today as warbirds in pseudo-Soviet colour schemes.

Yakovlev Yak-11

Formed From Fighters

The Yakovlev OKB designed some of the best Soviet wartime fighters. The need to teach students combat skills in a high-performance aircraft saw the Yak-3 adapted into the Yak-11, which became the standard advanced trainer of the USSR and its post-war allies.

Designed to counter the newer FW-190 and BF-109G fighters, the Yak-3 was particularly effective at lower levels, below 11,000ft (3,350m). Powered by a 1,300hp (970kW) V-12 Klimov VK-105PF-2 engine, it entered service with the Soviet Air Force in July 1944.

With a tandem cockpit and new canopy and an ASh-21 radial, the Yak-3UTI for Uchebno Trenirovochnyi Istrebitel (Fighter Trainer) flew on 10 November 1945, piloted by G.S. Klimushkin. After successfully passing its state acceptance trials it was ordered into production at plant No. 292 in Saratov as the Yak-11 in 1946 and entered service the following year. With a wider fuselage, the metal wing had 8in (20cm) greater span than the Yak-3's. With less than half the engine power and a two-bladed variable-pitch propeller, the performance was understandably lower, but still enough to challenge a student pilot.

For weapons training the Yak-11 had a single machine-gun in one wing and could carry a pair of 50kg bombs. A gun camera could be used to judge shooting accuracy. The flaps, landing gear and brakes are operated by pneumatic systems. Compared to hydraulics they are lighter and more reliable in a wide range of temperatures.

The Yak-11 became the Eastern Bloc equivalent of the T-6/Harvard family, although remained in production for much longer. Continuous improvements were made including the replacement of the wooden rear fuselage framework with metal.

There were 3,859 produced in Soviet factories at Saratov and Leningrad and a further 707 built by LET in Czechoslovakia as the C.11.

Yak-11U had a nose wheel undercarriage more suitable for training aspiring jet pilots.

Air forces equipped with Yak-11s included Albania, Algeria, Angola, China, Egypt, Iraq, Mongolia, North Korea, Somalia, Syria, Vietnam and Yemen. Austria was a rare Western operator, reportedly acquiring four left behind when Soviet occupation forces finally withdrew in 1955. Egypt retired its 40 or so Yak-11s in 1970 and stored/abandoned them in the desert. A number of them were recovered in the 1980s by French enthusiasts and converted to civilian use, often masquerading as wartime fighters. Some have been modified for Unlimited air racing with a variety of engines up to and including the 3,700hp (2,760kW) Wright R-3350. ■

Yakovlev Yak-11

Crew: Two
Length: 27ft 11in (8.50m)
Wingspan: 30ft 10in (9.40m)
Height: 10ft 9in (3.28m)
Empty weight: 4,189lb (1,900kg)
Max T/O weight: 5,379lb (2,603kg)
Powerplant: One Shvetsov ASh-21 radial piston engine rated at 570hp (425kW)
Max speed: 289mph (465km/h)
Service ceiling: 23,295ft (7,100m)
Range: 795 miles (1,279km)
Armament: One 12.7mm UBS or 7.7mm SjKAS machine-gun; up to 440lb (200kg) of ordnance

A pair of Finnish Saab 91Ds. SF-15 was written off in March 1961, but SF-16 was later sold on the civil market and is airworthy today in Finland as OH-SFN. *Saab*

Saab 91 Safir

Swedish Sapphire

Owing its lineage to a pre-war Luftwaffe aircraft, the Safir was in production for 20 years and in service into the 1990s.

Work on what would become Saab's S.91 Safir (Sapphire) began in 1944 as a civil trainer and tourer aircraft. The designer, Anders Andersson, had been responsible for the German Bucker Bestmann, which it resembled in many respects, although the Swedish aircraft was slightly larger and had a retractable tricycle undercarriage.

Following a first flight of SE-APN on 20 November 1945 and a short test programme, series production began in the spring of 1946. The S.91A had a 145hp (108kW) de Havilland Gipsy Major 10 engine and an empty weight of 580kg (1,280lb). Most of the 48 built went to the Imperial Ethiopian Air Force or to the Swedish Air Force (Flygvapnet) as Tp 91 liaison aircraft.

The major production version was the S.91B with a 190hp (142kW) Lycoming O-435-A engine. It was selected as a new primary trainer, the Sk 50, for the Swedish AIr Force in 1951, but Saab lacked the capacity and sub-contracted production to De Schelde at Dordrecht in the Netherlands. This plant built 120 S.91Bs up to 1955, many of them for airline flying schools, including KLM, Sabena Belgian Airlines and Lufthansa. De Schelde also built 41 of a four-seat S.91C model.

In 1956, following a Royal Norwegian Air Force order for 25 S.91B-2s, production resumed at Linköping. Finland and the Dutch government's airline pilot's school purchased the S.91D and took 20 and 19 examples, respectively.The S.91D, differed from its predecessors by incorporating a lighter Lycoming 180 hp (134kW) O-360 engine. Tunisia bought 15 S.91Ds in 1960 and Austria also purchased 24 of this version in 1964, using the type until 1992.

Sweden eventually operated 98 S.91s, mostly in the training role, but some remained in use as liaison aircraft as late as 1994. The second-biggest user after Sweden was Ethiopia, which bought 18 S.91As in 1946, 14 S.91Bs in 1954 and 16 S.91Cs in 1960. Swedish Air Force chief of staff Count von Rosen delivered one S.91A to Addis Ababa in a non-stop flight. Apart from an additional fuel tank in the cabin, the aircraft was unmodified.

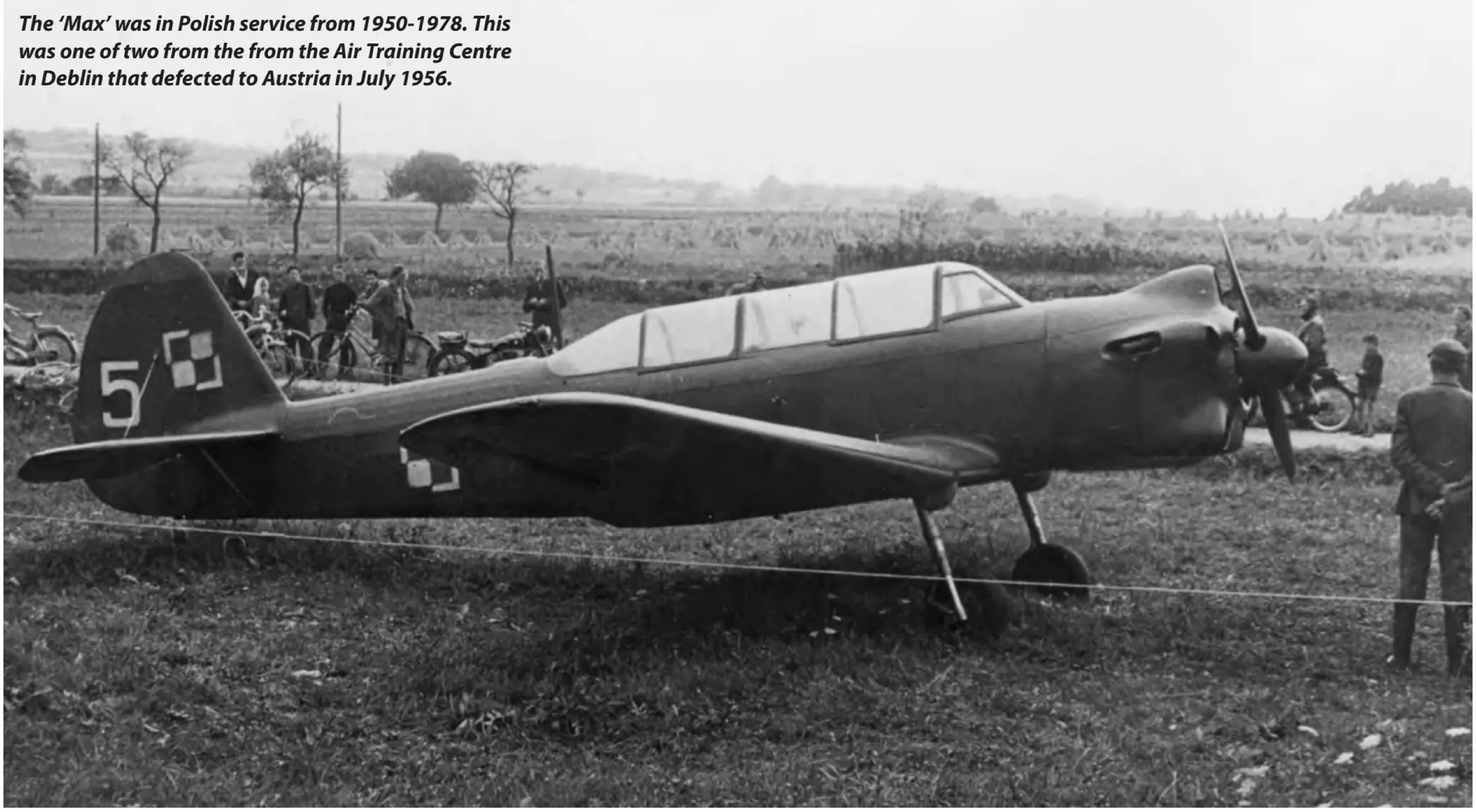
Total Safir production was 323 and ended in 1966 with the delivery of the last aircraft to Ethiopia.

One was supplied to Japan for aerodynamic research work. The Saab 201 was a Safir fitted with a swept wing as part of the development of the J 29 Tunnan jet fighter.

The Safir has proved a popular warbird, with many flying in private hands, including some examples recovered in the late 1990s from Ethiopia. ■

Saab 91B Safir

Crew: Two or three
Length: 25ft 11in (7.90m)
Wingspan: 34ft 9in (10.60m)
Height: 7ft 3in (2.20m)
Empty weight: 1,630lb (740kg)
Max T/O weight: 2,736lb (1,218kg)
Powerplant: One Lycoming O-345A flat-four piston engine rated at 190hp (108kW)
Max speed: 170mph (270km/h)
Service ceiling: 20,3240ft (6,200m)
Range: 653 miles (1,050km)
Armament: None


The 'Max' was in Polish service from 1950-1978. This was one of two from the from the Air Training Centre in Deblin that defected to Austria in July 1956.

Yakovlev Yak-18

Soviet Staple

To meet the requirement for an aircraft suitable for training pilots on higher performance aircraft Alexander S. Yakovlev's team took the UT-2, which first flew in July 1935, as the starting point.

The Soviet Air Force began work on a new trainer in the middle of World War Two. The types then in service were the Polikarpov UT-1/Po-2 biplane and the Yakovlev UT-2 and Yak-5 monoplanes which had open cockpits and fixed landing gear. The open cockpit was enclosed and the tail skid replaced with a tailwheel. The UT-2MV prototype, still with a fixed landing gear, flew in 1944. It retained fabric and steel tubing construction. The most distinctive feature was the close-fitting cowling with bulges over each of the five cylinders of the 160hp (119kW) Shvetsov M-11FR radial engine.

Series production began in 1947 as the Yak-18 with a retractable undercarriage. Many Yak-18s were issued to DOSAAF (Voluntary Society for Collaboration with the Army, Air Force and Navy, which sponsored aero clubs throughout the USSR.

Known under the Nato reporting system as the 'Max', it was provided to numerous Soviet client states including Afghanistan, Albania, Armenia, Bulgaria, Cambodia, China, Egypt, Guinea, Hungary, Iraq, Laos, Mali, Mongolia, North Korea, Poland, Romania, Somalia, Turkmenistan, North Vietnam, Yemen and Zambia. Austria was an unusual operator, receiving four Yak-18s donated by the USSR in 1955.

In the Korean War it was used for night harassment missions and nicknamed 'Bedcheck Charlie' or 'Washing Machine Charlie' by UN troops. Yak-18s would fly behind allied lines, making noise and dropping small bombs here and there to keep soldiers awake. In June 1953 they hit a fuel dump at Incheon in what was the most successful North Korean air raid of the war, destroying 5m gallons of gasoline.

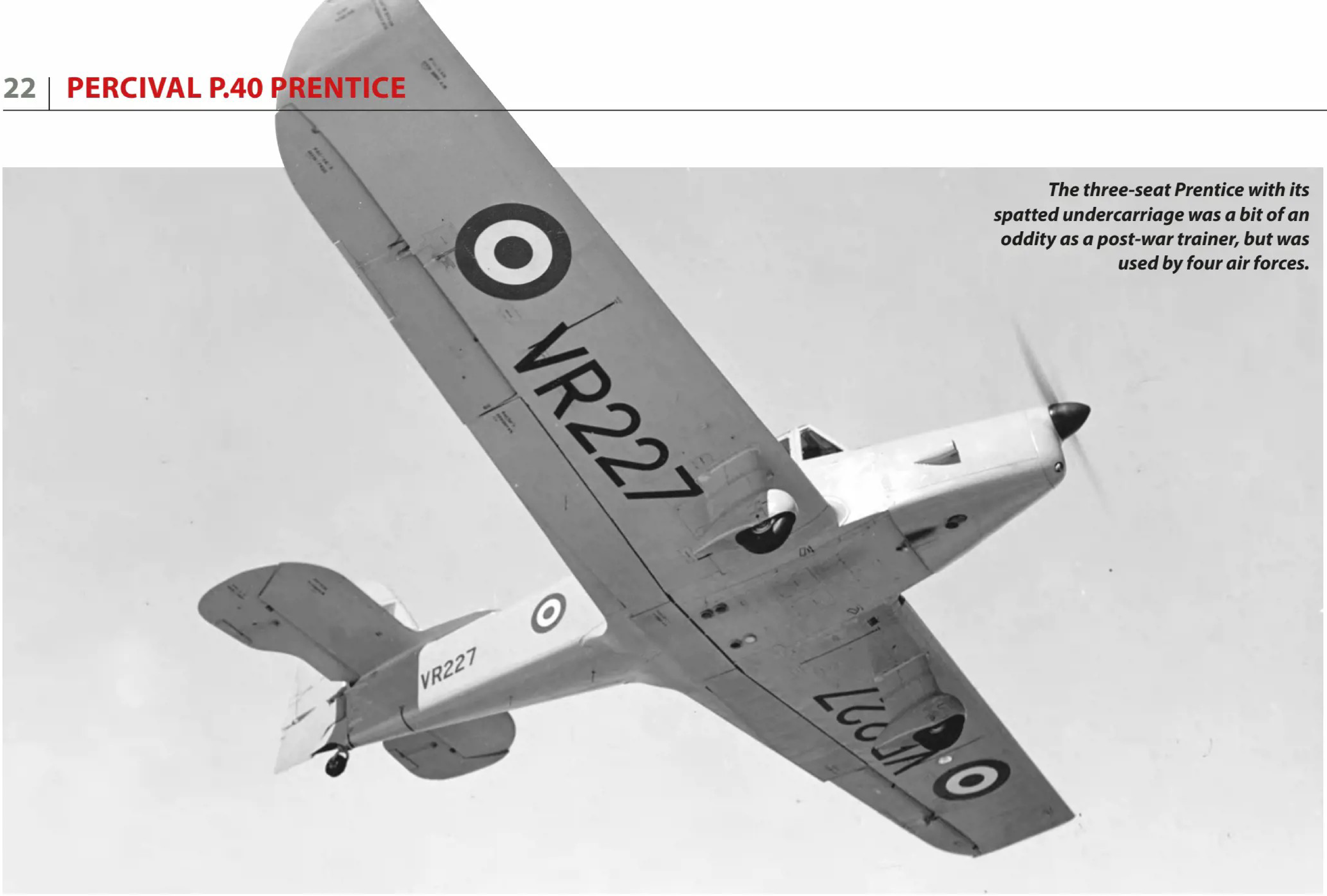
Yakovlev production ended in 1956, but the design was sold to China in 1954 as the CJ-5 and a total of 379 were produced by Nanchang under licence up to 1958.

A substantial reworking of the design in 1955 produced the Yak-18U. It had a tricycle undercarriage with forward-retracting mainwheels. The lower half of the wheels were exposed, protecting the belly in the event of a wheels-up landing. It is said that the gear was only retractable to teach students the use of such systems rather than to reduce drag and improve performance. Yak-18Us also had a smooth cowling, a longer nose mounting a Ivchenko AI-14R nine-cylinder radial and increased dihedral on the outer wings.

The single-seat Yak-18P and PM versions were very successful in aerobatic competition. The Yak-18T was a four- or five-seat cabin version with side-by-side seating. More than 1,000 were built and production continued into the 1980s. ■

Yakovlev Yak-18

Crew: Two
Length: 28ft 0in (8.53m)
Wingspan: 34ft 9in (10.60m)
Height: 11ft 0in (3.35m)
Empty weight: 2,260lb (1,025kg)
Max T/O weight: 2,900lb (1,316kg)
Powerplant: One Ivchenko AI-14R radial engine rated at 260hp (194kW)
Max speed: 163 miles (262km/h)
Service ceiling: 16,600ft (5,060m
Range: 466 miles (750 km)
Armament: Up to 675lb (306kg) of stores



The three-seat Prentice with its spatted undercarriage was a bit of an oddity as a post-war trainer, but was used by four air forces.

Percival P.40 Prentice

Post War ab initio

www.xsava.xyz

A much larger, more complex cabin monoplane aircraft, capable of carrying two trainees as well as an instructor, the Percival Prentice was created to replace the de Havilland Tiger Moth within RAF Flying Training Command.

The Prentice was designed to meet Specification T.23/43 as a fully aerobatic, all-weather ab initio trainer fitted with radio equipment. Work started in late 1944 as the 'Aj' design, with the first of five flying prototypes (TV163) making its maiden flight on 31 March 1946 in the hands of Captain Leonard Turnell Carruthers, Percival's chief test pilot. Early flights demonstrated the aircraft was laterally instable, resulting in the wingtips being turned up by 30°. Rudder area was also increased to counter unsatisfactory spinning characteristics, while anti-spin strakes were fitted. These made little difference, however, and several tail configurations were tested before the problem was cured.

Six pre-production Prentice T.1s were built, the first going to the Empire Flying School at Hullavington, Wiltshire, on 27 August 1947, although the Prentice did not officially enter service until 1 October. Examples were delivered to the Central Flying School on 30 July 1948, by when the third seat for the second student, was no longer used. Deliveries to the RAF College at Cranwell began the following month, followed by 3 Flying Training School (FTS) at Feltwell, Norfolk, and then 6, 7, 22 and 2 FTSs. Percival delivered 222 production aircraft to the RAF, while Blackburn built another 125.

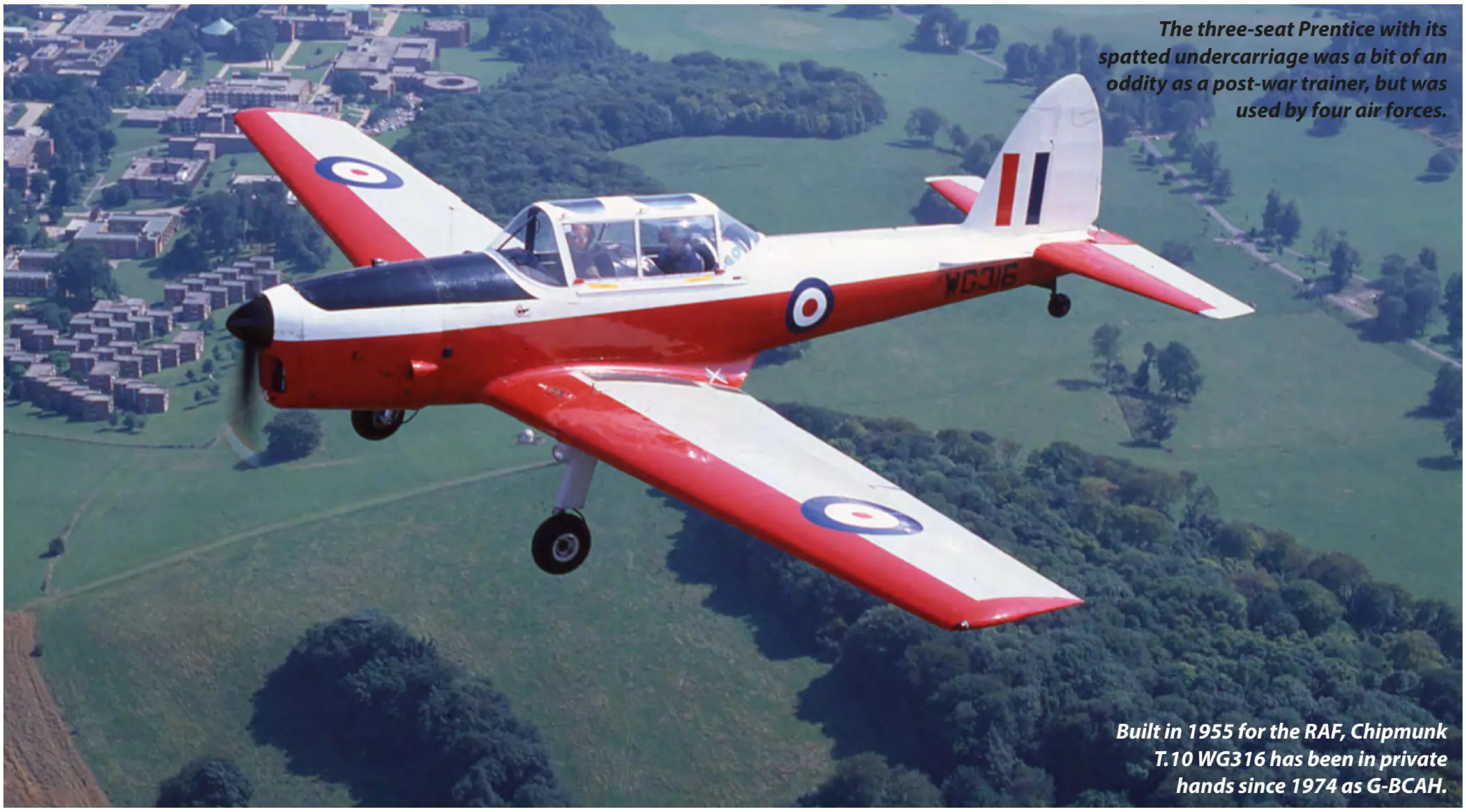
Prentices were also issued to eleven Reserve Flying Schools and served with University Air Squadrons. In addition to being flown as a pilot trainer, the Prentice was also utilised by 1 and 2 Air Signallers Schools (ASS) at Swanton Morley, Norfolk, and Halfpenny Green in Staffordshire, to train radio operators. Small numbers were also issued to various communications flights, while 31 Squadron at Hendon in north London had about seven as aerial taxis. The Prentice was replaced in the basic training role from 1954 by the Hunting Percival Provost, while 1 ASS withdrew the last from RAF service in mid-1956. A total of 252 Prentices were bought by Aviation Traders, which sold 28 on the civil market.

A single Prentice T.2, with a supercharged Gipsy Queen 51, was evaluated by Canada, while the prototype T.3 had a Gipsy Queen 71, turning a three-blade propeller. India ordered 20 and a further 42 were assembled by Hindustan Aeronautics Ltd, although they had the standard two-blade propeller. The first flew in April 1948 and all were delivered by the end of 1949. They served with 2 Air Force Academy at Jodhpur between 1951 and 1956, from Tambaram and Ambala as trainers and with 52 and 55 Auxiliary Air Force Squadrons, along with some air observation post flights before being retired in 1959.

Argentina became the largest export customer, receiving 100 from September 1948. The only other operator was Lebanon, which received three when it established an air force in 1949. They were retired in 1962. ■

Percival Prentice T.1

Crew: Three
Length: 31ft 3in (9.53m)
Wingspan: 46ft 0in (14.02m)
Height: 12ft 11in (3.92m)
Empty weight: 3,232lb (1,466kg)
Max T/O weight: 4,200lb (1,905kg)
Powerplant: One de Havilland Gipsy Queen 32 piston engine, rated at 251hp (187kW)
Max speed: 143mph (230km/h)
Service ceiling: 18,000ft (5,486m)
Range: 505 miles (813km)
Armament: None



The three-seat Prentice with its spatted undercarriage was a bit of an oddity as a post-war trainer, but was used by four air forces.

Built in 1955 for the RAF, Chipmunk T.10 WG316 has been in private hands since 1974 as G-BCAH.

De Havilland Canada Chipmunk

The 'Chippie'

A total of 1,279 Chipmunks were built in three countries, the majority of which served with numerous air arms as elementary trainers. Although most had been retired by the late 1970s, a handful continue to fly in military colours today.

In 1945 de Havilland Aircraft of Canada (DHC) began work on a new elementary trainer. Under the design leadership of Wsiewołod Jakimiuk, an all-metal, tandem seat monoplane with an enclosed cockpit was created as the DHC-1 Chipmunk. Patrick Fillingham completed the first flight of the prototype CF-DIO-X at Downsview in Toronto, Ontario, on 22 May 1946, by when the name Chipmunk had been adopted.

The Royal Canadian Air Force (RCAF) received 113 DHC-1A-1s and -1B-2-S3/S5s as Chipmunk 1 and 2s, powered by Gipsy Major 1Cs and 10s, respectively, from 1948. From the 101st Chipmunk built the original canopy was replaced by a bubble unit, an improvement suggested by the RCAF. Most RCAF Chipmunks were used for ab initio training, but more than 30 went to flying clubs for the use of the service's reserve pilot. Canadian Chipmunks remained in service until 1972. Canadian-produced Chipmunks were also delivered to the air arms of Belgium (DHC-1A-1), Egypt (DHC-1B-2-S1), Lebanon (DHC-1B-2-S3) and Thailand (DHC-1B-2-S2). The last of 217 built at Downsview was delivered in 1956.

Canadian-built G-AJVD and G-AKDN were evaluated at Boscombe Down, Wiltshire, in late 1948, to glowing reviews. This resulted in Specification 8/48 being issued for a production version, with G-AKDN being equipped to RAF configuration for additional trials. On production Chipmunk T.10s built by de Havilland, initially at Hatfield, Hertfordshire, and later Hawarden near Chester, the landing gear legs were repositioned forward, the wings were stressed for 10g, and anti-spin strakes and landing lights fitted. The original cockpit canopy was retained.

The first two of 735 Chipmunk T.10s produced, WB549 and WB550, went to Boscombe Down in November 1949. The final example was delivered to the RAF on 1 October 1953. The initial RAF unit to re-equip with the aircraft was the Oxford University Air Squadron (UAS) based at Kidlington, Oxfordshire, which was quickly followed by the other UASs and the Reserve Flying Schools. During the early 1950s, when ab initio training was expanded in the RAF, the Chipmunk became the standard mount for National Service pilots undergoing training.

Chipmunks were reintroduced for the training of direct entry pilots on 1 July 1965, when the Primary Flying Squadron was formed within the Central Flying School at South Cerney, Gloucestershire, the unit later being retitled 2 Flying Training School (FTS). It continued to fly Chipmunks until June 1973, when they were replaced by Scottish Aviation Bulldogs. The final RAF units with Chipmunks were the Air Experience Flights

De Havilland Canada Chipmunk T.10

Crew: Two
Length: 25ft 8in (7.82m)
Wingspan: 34ft 4in (10.46m)
Height: 7ft 1in (2.16m)
Empty weight: 1,417lb (643kg)
Max T/O weight: 2,000lb (907kg)
Powerplant: One de Havilland Gipsy Major 8 piston engine, rated at 145hp (108kW)
Max speed: 138mph (222km/h)
Service ceiling: 16,000ft (4,877m)
Range: 259 miles (445km)
Armament: None

Chipmunk P-121 was the first of 27 T.20s delivered to Denmark in 1950-53. It is now in the Danmarks Flymuseum at Stauning.

(AEF) and the Elementary Flying Training School (EFTS) at Swinderby, Lincolnshire, the later disbanding on 1 April 1993. During 1995 the AEFs amalgamated with the UASs, retiring their Chipmunks in the process in favour of Bulldogs. The last to fly the aircraft was 10 AEF at RAF Woodvale, Merseyside, which gave up its Chipmunks in 1996.

In addition to its use as a trainer, the RAF Gatow Station Flight in Berlin used the aircraft to photograph Soviet installations and equipment around Berlin – and beyond the city's limits– between 1956 and 1990. Carrying hand-held cameras operated by the 'passenger' in the rear seat, they gathered considerable intelligence during the Cold War, occasionally at the expense of receiving the odd bullet fired by those being photographed. No.114 Squadron also operated Chipmunks on security patrols over Cyprus during 1958-59.

One of the last operations undertaken by the Chipmunk in RAF service was a round-the-world flight. Two of the aircraft set off in 1996, but were not permitted to go beyond Moscow; they became the first RAF to visit Russia since the war. A second attempt was mounted in 1997, the Chipmunks completing the 16,259 mile (26,166km) flight over 64 days. The RAF continues to have a pair of Chipmunk T.10s on its books, however; both are used by the RAF Battle of Britain Memorial Flight, allowing pilots to gain 'taildragger' experience before transitioning to its Hurricane and Spitfire.

Chipmunk T.10s were also used by the Fleet Air Arm and Army Air Corps as elementary trainers. The Admiralty operated 19 at various times, the majority serving with the Britannia Flight at Roborough, Devon, which flew them from June 1966 into 1993. Army Chipmunks served from its formation as a separate organisation on 1 September 1957, remaining with the Basic Fixed Wing Training Squadron at Middle Wallop, Hampshire, until retired in 1997.

An export version was built by de Havilland as the Chipmunk T.20, differing from the T.10 by having a Gipsy Major 10 Series 2, rather than a Mk 8. A total of 217 were built and sold to the Arab Legion, Burma, Ceylon, Denmark, Egypt, Iraq, Ireland, Lebanon, Malaysia, Portugal, Saudi Arabia, Syria and Thailand. Former RAF Chipmunk T.10s were also supplied to Ghana (12 in 1963), Kenya (nine in 1964), Malaysia, Southern Rhodesia and Zambia (six).

The third source of Chipmunks was Portugal, OGMA building 66 Mk 20s which entered service at Sintra in 1951 to join ten delivered by de Havilland. Replaced by Aérospatiale Epsilons by 1987, seven passing to the Air Force Academy as glider-tugs. From 1997 they were re-engined with Lycoming O-360s for use screening potential students, with six remaining in service in 2025. They are due to be replaced in 2026. ■

Portugal celebrated the 60th anniversary of the Chipmunk with this specially marked example. It is one of six still in service. Carlos Senra Barbosa/FAP

The Hungarian Air Force operated five Zlin Z43s, but have since retired the type with 075 becoming HA-BFI on the civil register.

Zlin Trainers

Czech Rides

Zlín has produced a diverse series of aircraft for civil and military use, mostly as trainers, but which have been used in a more warlike role by at least one operator.

Moravan Aviation was founded as the Zlín Aviation company at Zlín, Czechoslavia in 1934 and built light trainers before the war and German designs during it. After hostilities ended, the company responded to Czech government requirement for a two-seat trainer with the tandem seat Z-26 Tréner. After initial rejection because it didn't use a locally made Walter engine, the design was re-submitted, and approval for a prototype was given. This flew on 20 October 1947 and was soon ordered into production, which began in May 1948 and concluded with the 163rd C-120 for the Air Force. It was a tube-and-fabric design with a fixed undercarriage and a two-bladed wooden propeller.

The company adopted the Moravan name in 1953, using it until 1989 when it reverted to Zlín

Progressive modernisation saw the increased use of aluminium in the C-120 and production switched to the Z126 or Moravan Tréner 2 in 1953, leading to the Z226 Tréner 6, which started as a glider tug but proved an extremely capable aerobatic aircraft when superfluous equipment was removed. In the hands of Czech pilots the two-seat Z226T won the World Aerobatics Championships in 1960 and variants of the 226 would dominate the scene for many years.

The Zlin 42 side-by-side trainer built on the success of the Tréner family and first flew in October 1967. The Z42M had a revised tail and 142 were produced, followed by the Z242 with a 200hp (149 kW) engine.

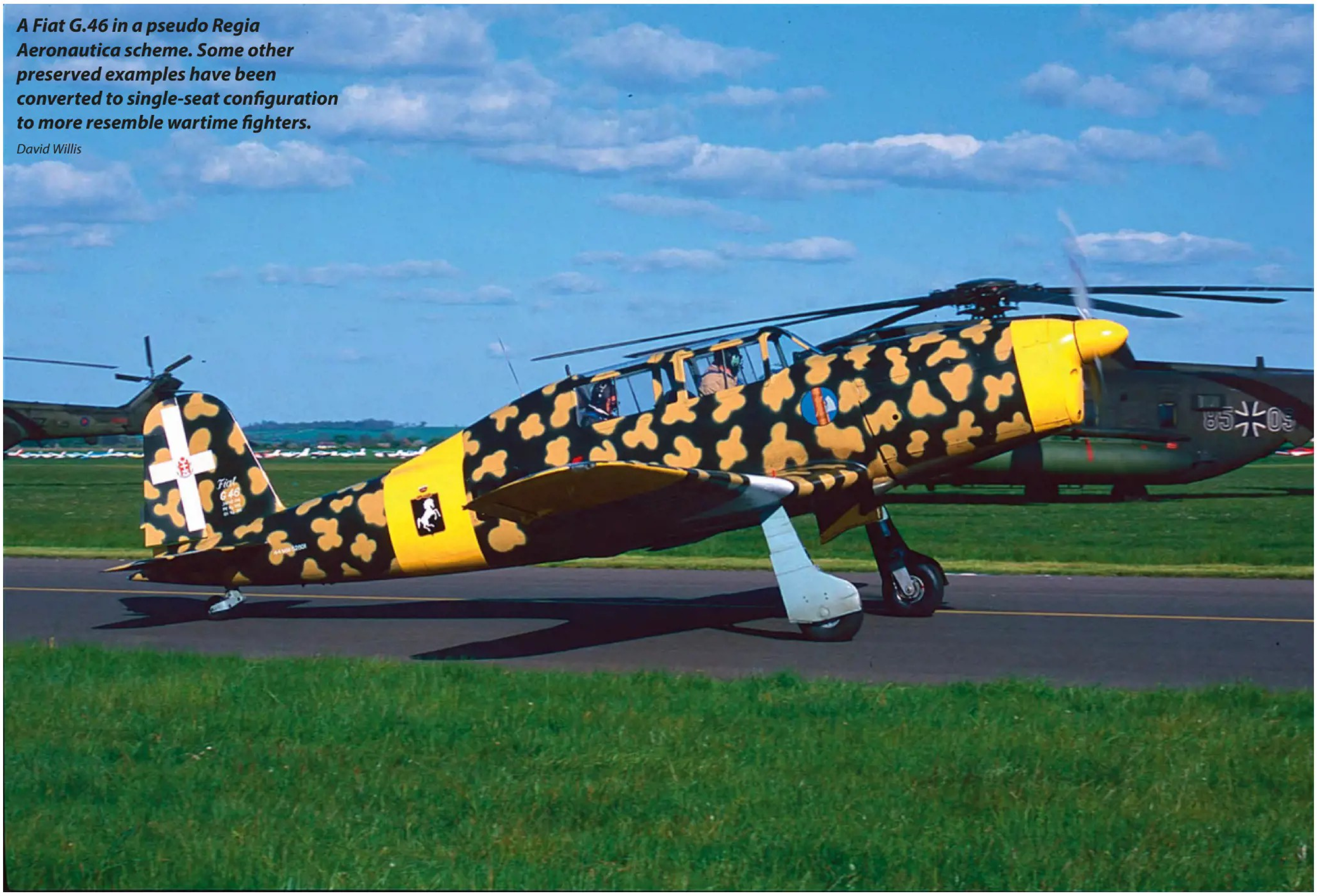
Military customers for this series include Algeria, which has produced a licensed version of the Z242 Zeus as the Fernas-142; Bolivia (nine Z242s); Croatia (four); Hungary (six); Kazakhstan (one); North Macedonia (five); Peru (three) and Slovenia (eight). The largest user is the Mexican Navy with 26 delivered from 2016 which are used for basic and aerobatic training

The Zlin 43 is a four-seater with a 210hp (160kW) Avia M 337 engine. They were used by Algeria (as the locally assembled Safir-43); Cuba, East Germany, Hungary and North Macedonia. The Z143 has a Lycoming O-540 engine and is in service with Hungary (two); Mexican Navy (two) and North Macedonia (one).

In the Sri Lankan Civl War, the Tamil Tigers rebel group used civilian Zlin 143s as bombers in attacks on government targets including oil storage facilities and airfields. Two bomb-laden Zlins were shot down by AAA during a raid on the capital Colombo in February 2009, one crashing into the main tax office. ■

Zlin Z42M

Crew: Two
Length: 23ft 2in (7.07m)
Wingspan: 29ft 11in (9.11m)
Height: 8ft 10in (2.69m)
Empty weight: 1,422lb (645kg)
Max T/O weight: 2,138lb (970kg)
Powerplant: One Avia M 137AZ inverted inline piston engine rated at 180hp (130kW)
Max speed: 140mph (226km/h)
Service ceiling: 13,940ft (4,250m)
Range: 330 miles (530km)
Armament: None



A Fiat G.46 in a pseudo Regia Aeronautica scheme. Some other preserved examples have been converted to single-seat configuration to more resemble wartime fighters.

David Willis

Fiat G.46 and G.59

Italian Stallions

With a lineage stemming from wartime fighters, the Fiat G.46 intermediate and G.59 advanced trainers were some of the first post-war Italian-made aircraft, helping re-establish the country's aviation industry.

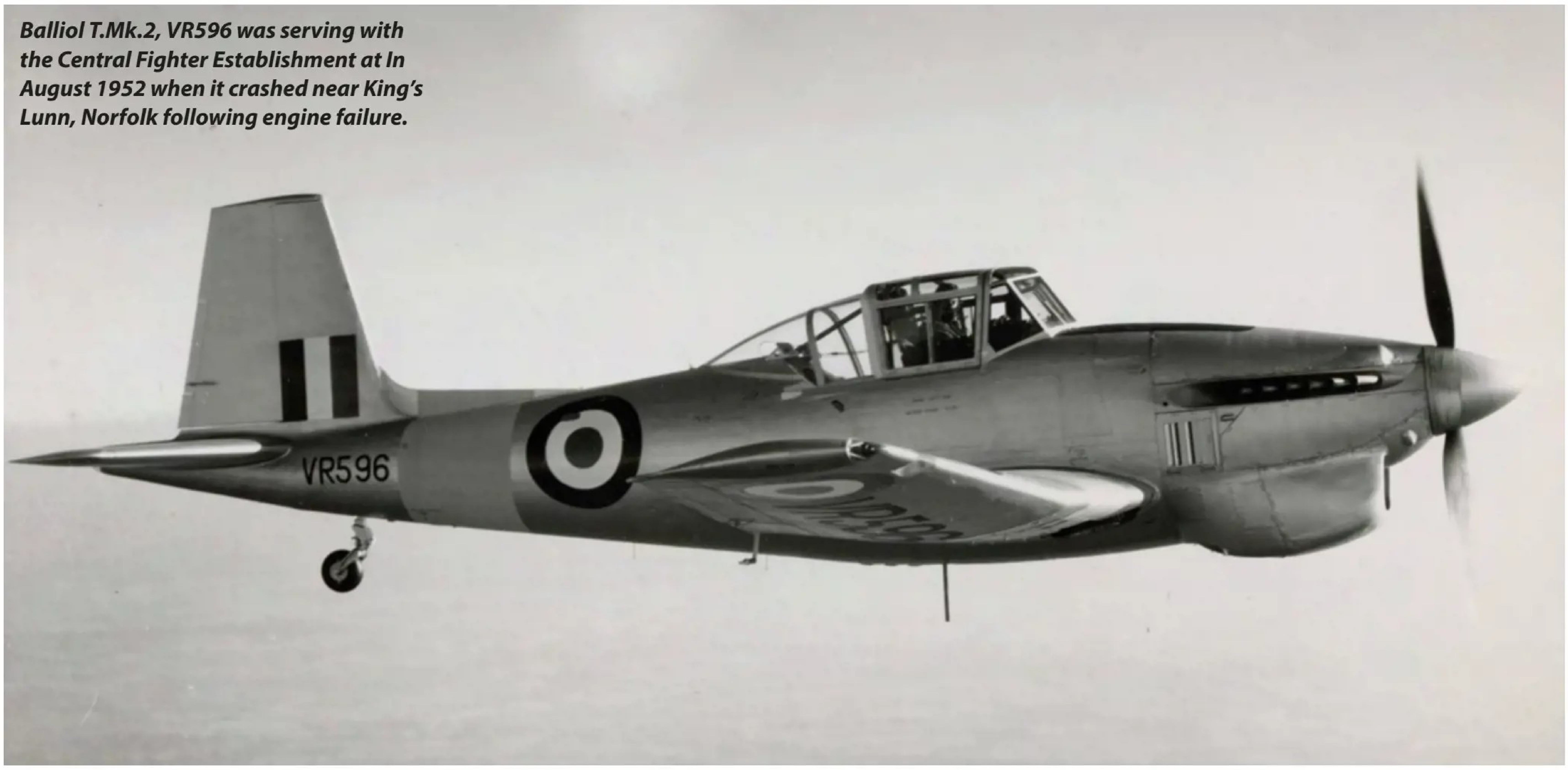
As part of the modernisation of the Aeronautica Militaire Italiano as Italy prepared to join Nato, the AMI commissioned a new trainer designed by Giuseppe Gabrielli, who was behind the Fiat G.50 and G.55 fighters. The first flight of the G.46 took place on 25 February 1948. Series 1 aircraft began service with the AMI's flying schools in 1949. At this time students began basic instruction on the Stinson L-5 Sentinel, moving to the G.46, then the T-6 or the Fiat G.55. When the AMI restructured its flying syllabus, they did away with the earlier stages, beginning instruction with the T-6 before moving on to the T-33 jet. Most G.46s became surplus and were demilitarised and supplied to civilian flying clubs or used by minor units for officer currency flying or communications duties. Argentina received 70 Gipsy Queen-powered examples and Syria had 11. Production concluded with the 223rd airframe.

The Fiat G.59 actually began as a fighter, the G.55 Centauro, of which the AMI found itself with more airframes than they had Daimler-Benz DB 603 engines. One airframe was modified to take a Rolls-Royce Merlin 24 engine and this was followed by the G.59BM two-seat fighter-trainer in early 1948. A dozen G.55s were rebuilt as single-seat G.59-1A fighter-trainers for the AMI, followed by G.59-1B two-seaters and 20mm cannon-armed single-seat G.59-2s, 26 of which were delivered to Syria from re-opened production lines. The final variants were the G.59-4A single-seater and G.59-4B two-seater of which ten and 20 were delivered to the AMI, respectively. These had cut-down rear fuselages with bubble canopies.

The last of approximately 180 AMI G.59s were phased out by 1964 as jets took over. Only five examples are known to exist today, and just one in flyable condition. ■

Fiat G.46

Crew: Two
Length: 27ft 10in (8.47m)
Wingspan: 34ft 1in (10.30m)
Height: 7ft 10in (2.37m)
Empty weight: 2,442lb (1,107kg)
Max T/O weight: 3,102lb (1,407kg)
Powerplant: One Alfa-Romeo 115ter piston engine rated at 225hp (167kW)
Max speed: 196mph (315km/h)
Service ceiling: 17,400ft (5,300km)
Range: 500 miles (960km)
Armament: None


Balliol T.Mk.2, VR596 was serving with the Central Fighter Establishment at In August 1952 when it crashed near King's Lunn, Norfolk following engine failure.

Boulton Paul P.108 Balliol

The RAF's Last Piston Advanced Trainer

The Boulton Paul Balliol had a complicated gestation and its career as a trainer with the RAF was cut short. While 196 Balliol T.2s followed three T.1 prototypes, by the time production was under way the RAF had already decided to use jet advanced trainers.

Designed as a three-seat turboprop to Specification T.7/45, Lindsay Neale made the maiden flight of the first prototype (VL892) on 30 May 1947. While it was, powered by a Bristol Mercury 30, the second (VL917) used an Armstrong Siddeley Mamba, intended for the production aircraft. It's maiden flight on 24 March 1948 was the first by a single-engined turboprop-powered aircraft. By then, however, RAF interest in turboprop three-seat trainers had waned and the Balliol (named for an Oxford college) was revised to Specification T.14/47, which called for a piston-engined, two-seat advanced trainer.

Four Balliol T.2 prototypes were produced with Rolls-Royce Merlin 35, the first flying on 10 July 1948. They were followed by 17 pre-production examples for an intensive service trial against the Avro Athena T.2, which was undertaken by the Central Flying School. The Balliol was selected in February 1950 and 238 ordered from Boulton Paul, plus 100 to be assembled by Blackburn.

Balliols entered service that year with 7 Flying Training School at RAF Cottesmore, Rutland, in 1950, but widespread adoption was curtailed as the RAF wanted jet trainers. Boulton Paul built just 140 production T.2s for the RAF and Blackburn another 30. Others were issued to No. 288 Squadron and 238 Operational Conversion Unit, which flew them until September 1957 and early 1958, respectively, to provide targets to train airborne radar operators. The last RAF Balliols were retired by the RAF in 1960.

Admiralty interest in the aircraft began in early 1950, resulting in a pre-production example being converted as the prototype Sea Balliol T.Mk 21. A further pair of Balliol T.2s were fitted with arrestor hooks for evaluation, one being tested on the airfield dummy deck at Boscombe Down, Wiltshire. The first of 30 production Sea Balliol T.21s flew on 23 October 1952.

Sea Balliols served with station and ship's flights, while from 1954 five Royal Navy Volunteer Reserve squadrons (Nos. 1831, 1832, 1834, 1840 and 1844) each had a pair, until the Air Branch of the RNVR disbanded in March 1957. Between October 1957 and July 1959 it was used for the Junior Officers Air Course, run by Nos. 702, then 781 and finally 727 Squadrons. The last Sea Balliols with the Admiralty were retired by the Abbotsinch Station Flight in September 1963.

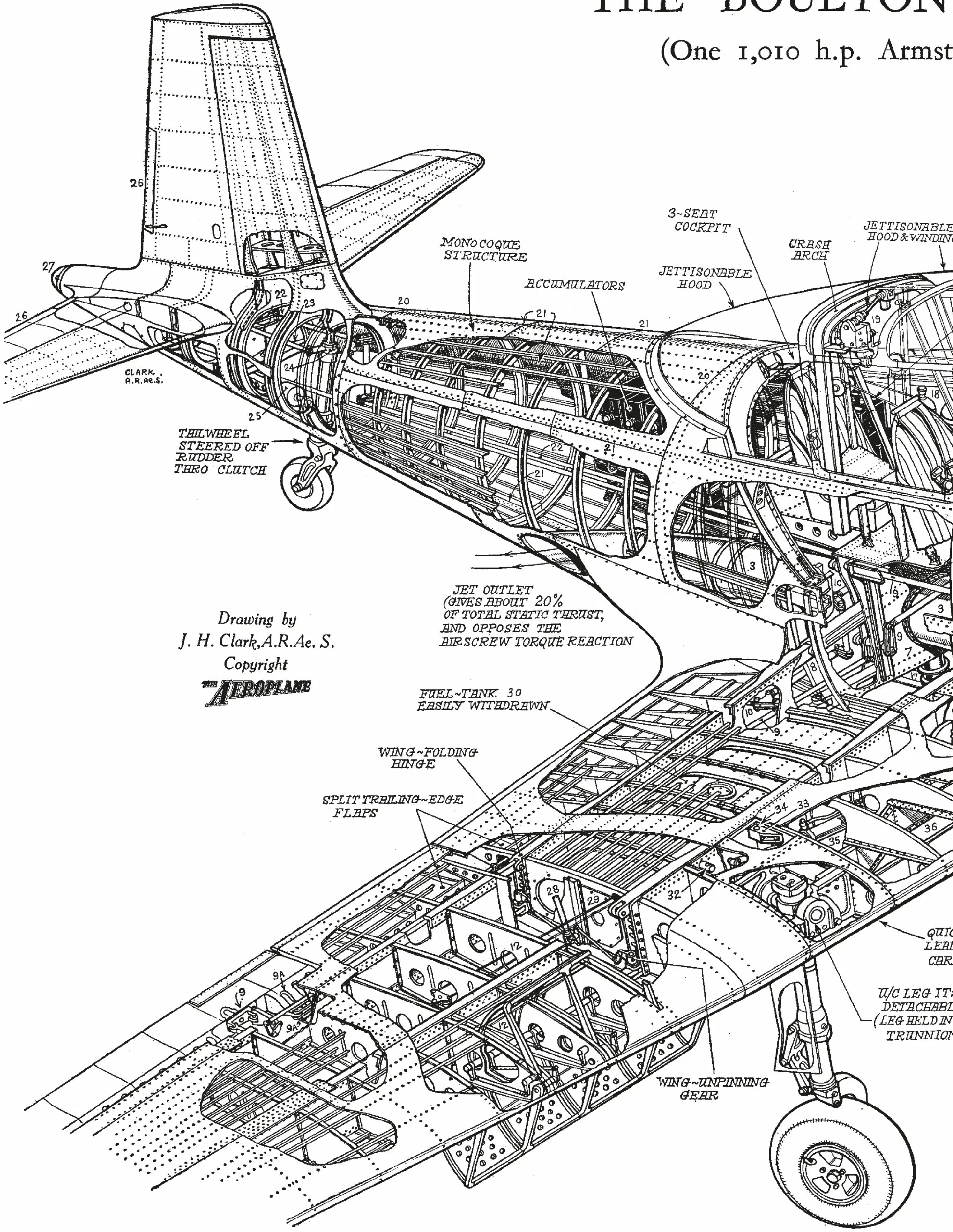
The final Sea Balliol T.21 (WP333), which was the last aircraft built by Boulton Paul to fly on 7 December 1954, served with the Aeroplane and Armament Experimental Establishment at Boscombe Down until it was replaced by WL732. That aircraft became the final airworthy Balliol in the UK, making its last flight on 7 February 1969. During the same year, the only export customer also retired the Balliol. The Royal Ceylon Air Force had received 12 Balliol T.2s used or ordered by the RAF in 1953. ■

Boulton Paul Balliol T.2

Crew: Two
Length: 35ft 2in (10.71m)
Wingspan: 39ft 4in (11.99m)
Height: 12ft 6in (3.81m)
Empty weight: 6,730lb (3,053kg)
Max T/O weight: 8,410lb (3,815kg)
Powerplant: One Rolls-Royce Merlin 35 piston engine, rated at 1,245hp (929kW)
Max speed: 288mph (463km/h)
Service ceiling: 32,500ft (9,906m)
Range: 660 miles (1,062km)
Armament: One 0.303inBrowning machine-gun and provision for four 60lb rocket projectiles

THE BOULTON

(One 1,010 h.p. Armst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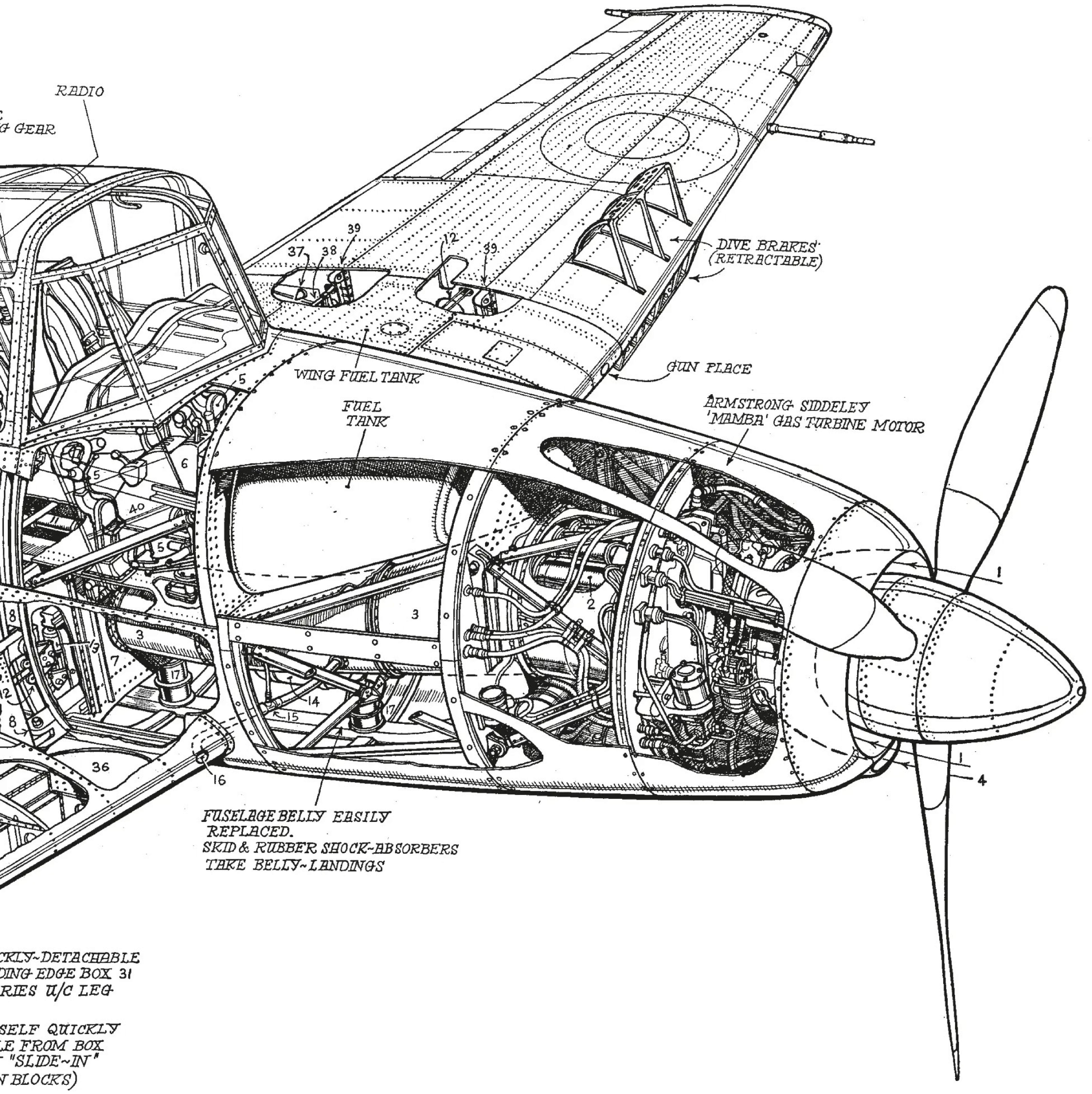
Drawing by J. H. Clark, A.R.Ae.S.
Copyright
THE AEROPLANE

PAUL BALLIOL T.Mk.1

rong Siddeley Mamba airscrew turbine)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LE FROM BOX
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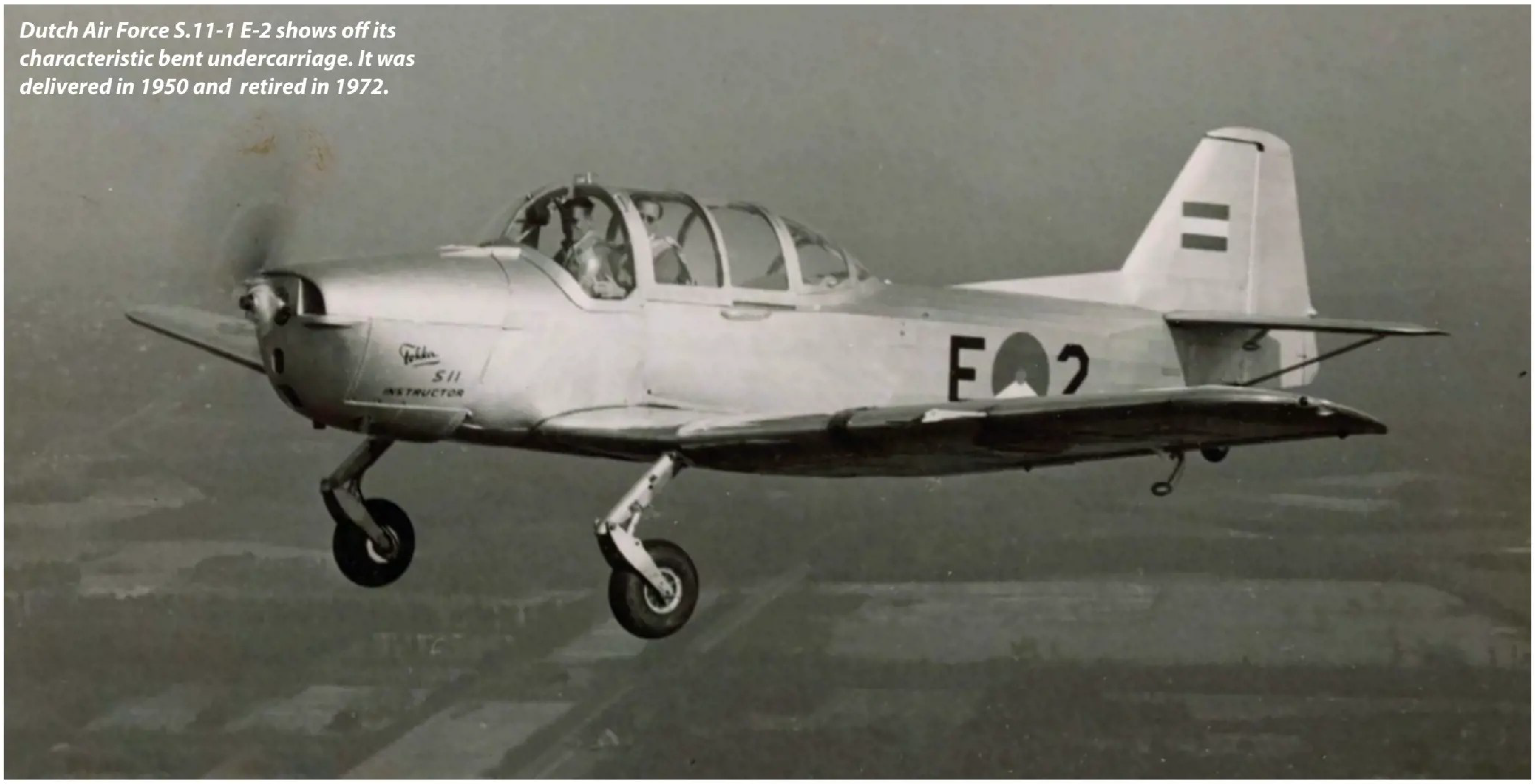
N BLOCKS)

1. Gas turbine intake air.
2. Combustion cans.
3. Jet pipe from turbine.
4. Cooling air.
5. Dual rudder bars and sticks.
6. Control pedestal.
7. Main cross-members pick up inboard-wing roots (8).
9. Aileron linkage.

9A. Aileron mass balance and groove to equalize airflow.

10. Flap linkage.
11. Flap pneumatic jack.
12. Dive brake controls.
13. Dive brake pneumatic jack.
14. Main supply bottle (pneumatic flaps, dive brakes, U/C).
15. Cockpit ventilating (cold air inlet at 16).
17. Rubber shock-absorbers.
18. Oxygen bottles.
19. Hand-electric winding gear to canopy.
20. Rear fuselage joints.
21. Plating joints.
22. Rudder control.
23. Rudder connection to tailwheel.
24. Tailwheel steering clutch.
25. Sliding (adjustable position) balance-weight.
26. Rudder and elevators hand trim.
27. Glider tow-hook and navigation light.
28. Handle slides down through underwing surface; then operate to unpin wing.
29. Remove end-plate to extract fuel tank (30).
31. Leading-edge box held to spar by four spigots (32) in lugs (33) pinned by bolts (34).
35. U/C pneumatic jack.
36. U/C wheel-well.
37. Inboard-to-outboard flap connector (spigot).
38. Aileron connection.
39. Wing-folding lugs.
40. Slide-up amber screens to windshield.


Dutch Air Force S.11-1 E-2 shows off its characteristic bent undercarriage. It was delivered in 1950 and retired in 1972.

Fokker S.11 Instructor

Dutch Master

Fokker anticipated the need for a modern trainer to help with the post-war renewal of the Dutch Air Force and private flying. The S.11 and derivatives became the primary trainers of four nations.

Local company Frits Diepen Aircraft NV ordered 100 S.11s before the first flight, planning to sell 70 to private owners, ten to the Air Force and the rest to aviation schools.

Company test pilot Gerben Sonderman made the first flight of PH-NBE on 18 December 1947. The S.11 featured side-by-side seating "in the British manner" as Fokker put it and the crew sat under a sliding Plexiglas hood with a fixed rear section. A side-opening hatch allowed access to the rear cockpit for a passenger or second student. The rear seat was later omitted, but the space could be used for luggage stowage or a radio unit.

The fuselage was of welded steel truss construction with plywood sheeting around the cockpit and a linen covering overall. Wings were aluminium with some components glued together, a technique that Fokker would use successfully on the F27 Friendship and later aircraft. The wing had fabric-covered aluminium ailerons and split flaps. The undercarriage was fixed with characteristic bent main legs. The windscreen frame was reinforced to be able to support the aircraft if it became inverted in a forced landing, allowing the occupants to escape. The hood was not jettisonable, something that was criticised in foreign evaluations.

Even though the S.11 was capable of basic aerobatics such as steep turns, Immelmann turns and slow rolls, a wing on the second prototype failed during a pull-out from a dive and it crashed, killing two Swedish pilots. The airframe was strengthened for subsequent aircraft.

During testing there were a number of stability problems. These were cured by enlarging the tail fin, lowering the tailplane position and lengthening the cockpit hood. The wing dihedral was increased and a fillet added.

The Frits Diepen order came to nothing, but thankfully the Dutch Air Force (LSK, later KLu) ordered 39 aircraft and in 1950 the first S.11-1 Instructors entered service. Israel also needed trainers and the third production aircraft was donated to the IDF/AF in late 1949 for evaluation. An order for 40 soon followed but they did not begin training pilots until early 1952. In Israeli service the Instructor suffered from overheating, broken undercarriages and other problems and were soon retired as primary trainers. Some were used as navigator trainers and for liaison and even tested with rockets, but they were out of service by 1956.

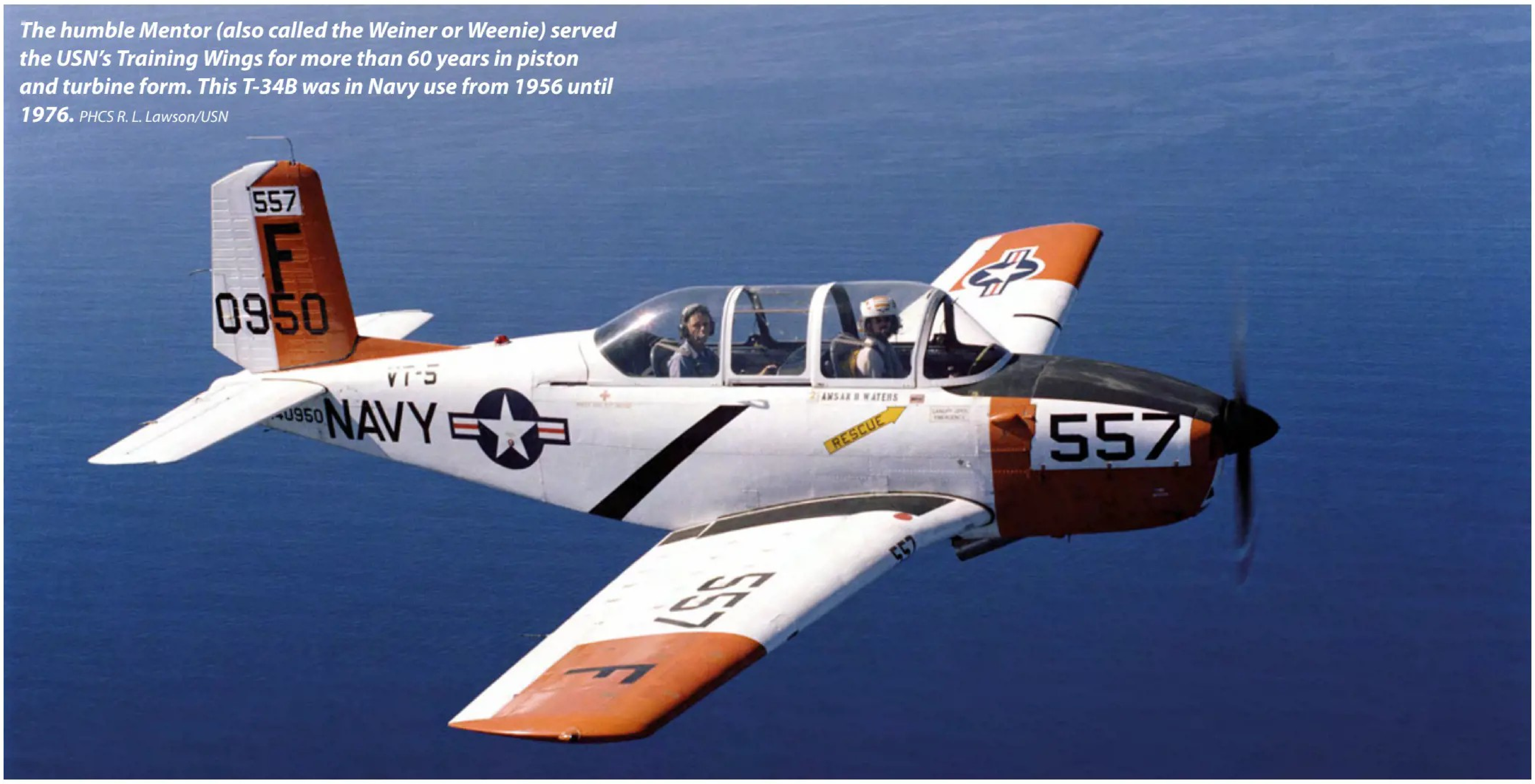
From 1959 the Netherlands Navy also operated the S.11. All Dutch examples were retired in 1973.

S.11s were manufactured under licence by Aermacchi in Italy as the Macchi M.416 of which 178 examples were built between 1951 and 1958. The aircraft was used as the standard primary flying training aircraft by the Italian Air Force until 1960.

Fokker Industria Aeronautica SA/Fabrica do Galeao built around 100 of the S.12, a version with a nose wheel undercarriage for Brazil. ■

Fokker S.11

Crew: Two or three
Length: 26ft 10in (8.18m)
Wingspan: 36ft 1in (11.0m)
Height: 7ft 3in (2.22m)
Empty weight: 1,786lb (810kg)
Max T/O weight: 2,425lb (1,100kg)
Powerplant: One Lycoming 0-435-A flat-six piston engine rated at 190hp (142kW)
Max speed: 130mph (209km/h)
Service ceiling:15,000ft (4,450m)
Range: 398 miles (641km)
Armament: None



The humble Mentor (also called the Weiner or Weenie) served the USN's Training Wings for more than 60 years in piston and turbine form. This T-34B was in Navy use from 1956 until 1976. PHCS R. L. Lawson/USN

Beech T-34 Mentor/Turbo Mentor

The 'Weenie'

Walter Beech tried to convince the Pentagon that a modern trainer would me simpler and more economical to operate than war-surplus T-6s and other types. Beech design studies included a V-tail and a four-seat fuselage. Although there was initial interest, the Korean War intervened and the programme was cancelled, with the USAF ordering new and rebuilt T-6s instead.

Beech reworked the Model 33 Bonanza into the Model 45 by replacing the cabin with a tandem cockpit and clear sliding clear hood. It had a Continental IO-520-B engine rated at 285hp (213kW). Vern Carstens flew the prototype on 2 December 1948.

Three YT-34s were evaluated at Randolph Field, Texas against the Fairchild T-31 and the Temco 33 Plebe. Unusually, students also flew the contenders and provided their opinions. The Beech was selected for the primary trainer requirement and ordered in March 1953. Because much of the tooling was the same as for the Bonanza, production stepped up quickly.

USAF T-34s were used to give 30 hours of introductory ab initio training before students went on to the T-28, but Air Training Command service of the T-34A was relatively brief. In 1961 the Air Force moved to an all-jet system utilising the Cessna T-37 and Northrop T-38 for primary through advanced training.

In June 1954 the US Navy chose the Mentor, with modifications. The T-34B lacked a fillet below the rudder and had a slightly increased wing dihedral. This improved its spin characteristics. The nose gear doors were also deleted.

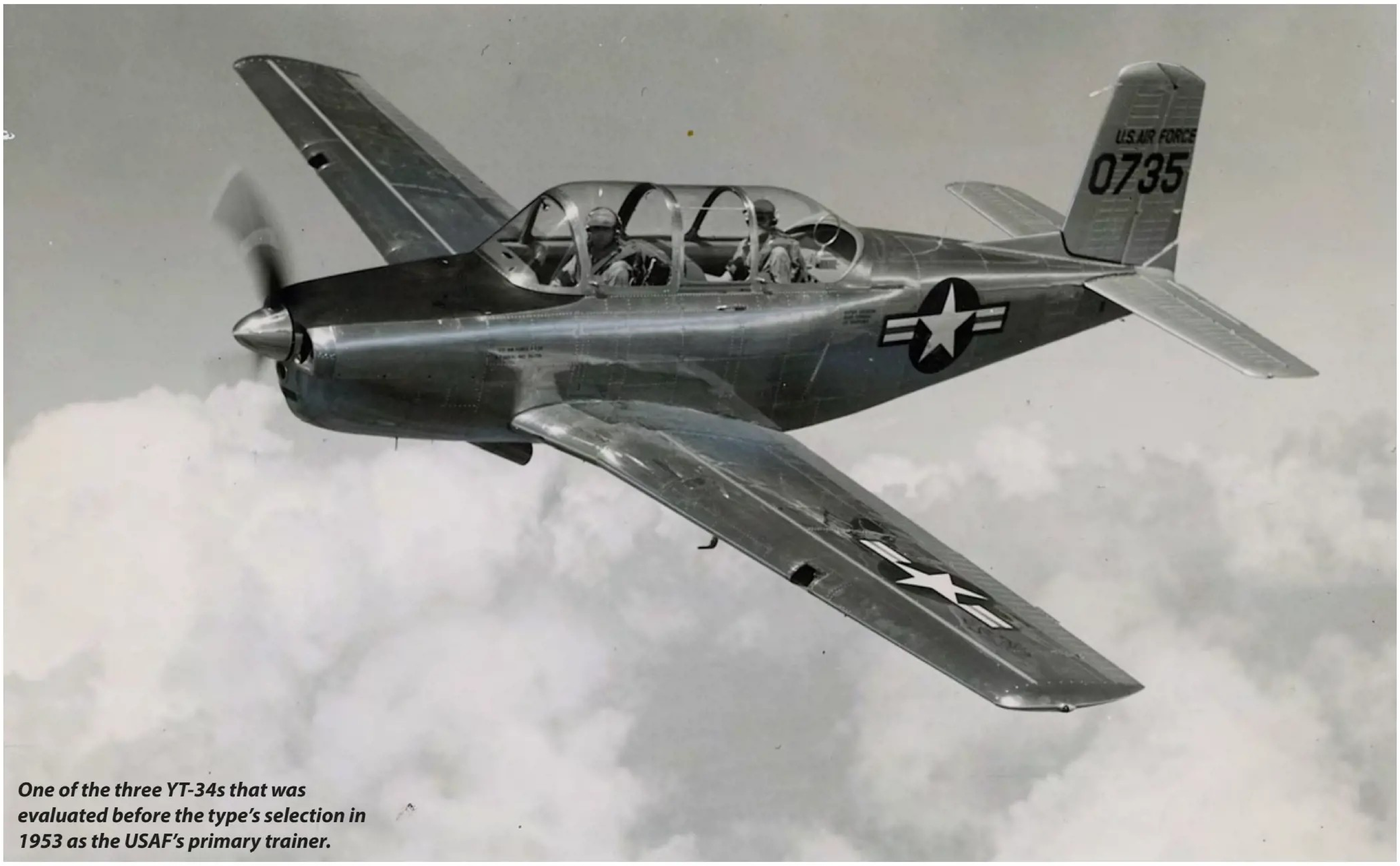
Again, production ramped up quickly and T-34Bs entered service with VT-1 at NAS Saufley Field, Florida. Part of Training Wing Six (TW-6), the complement of VT-1 was as many as 135 T-34Bs, with an expected availability of 127 every day. It was later joined at Saufley by VT-5, while VT-10 at Pensacola gave initial flying experience to Naval Flight Officer (NFO) candidates. Some T-34s were provided to the Navy's recruiting organisation and used to give familiarisation rides for potential aviation cadets.

Canadian Car and Foundry was awarded a contract to build 34 T-34As in 1953, but only 25 were operated by the RCAF and only used by one training course before being disposed of to Turkey under a mutual aid programme in 1956. Japan chose the Mentor as the first aircraft for its new National Security Force (Hoantai), which later became the Air, Maritime and Ground Self-Defense Forces. Beech supplied 18 T-34As and Fuji Heavy Industries built the remainder of what would amount to 144 for the JASDF, 20 for the JMSDF and nine for the JGSDF. A further 36 were provided to the Philippines as war reparations. Fuji also created several derivatives including the LM-1 Nikko with a four-seat cabin and the KM-2 with two side-by-side seats. The KM-2B had tandem seats but a wider fuselage than the T-34.

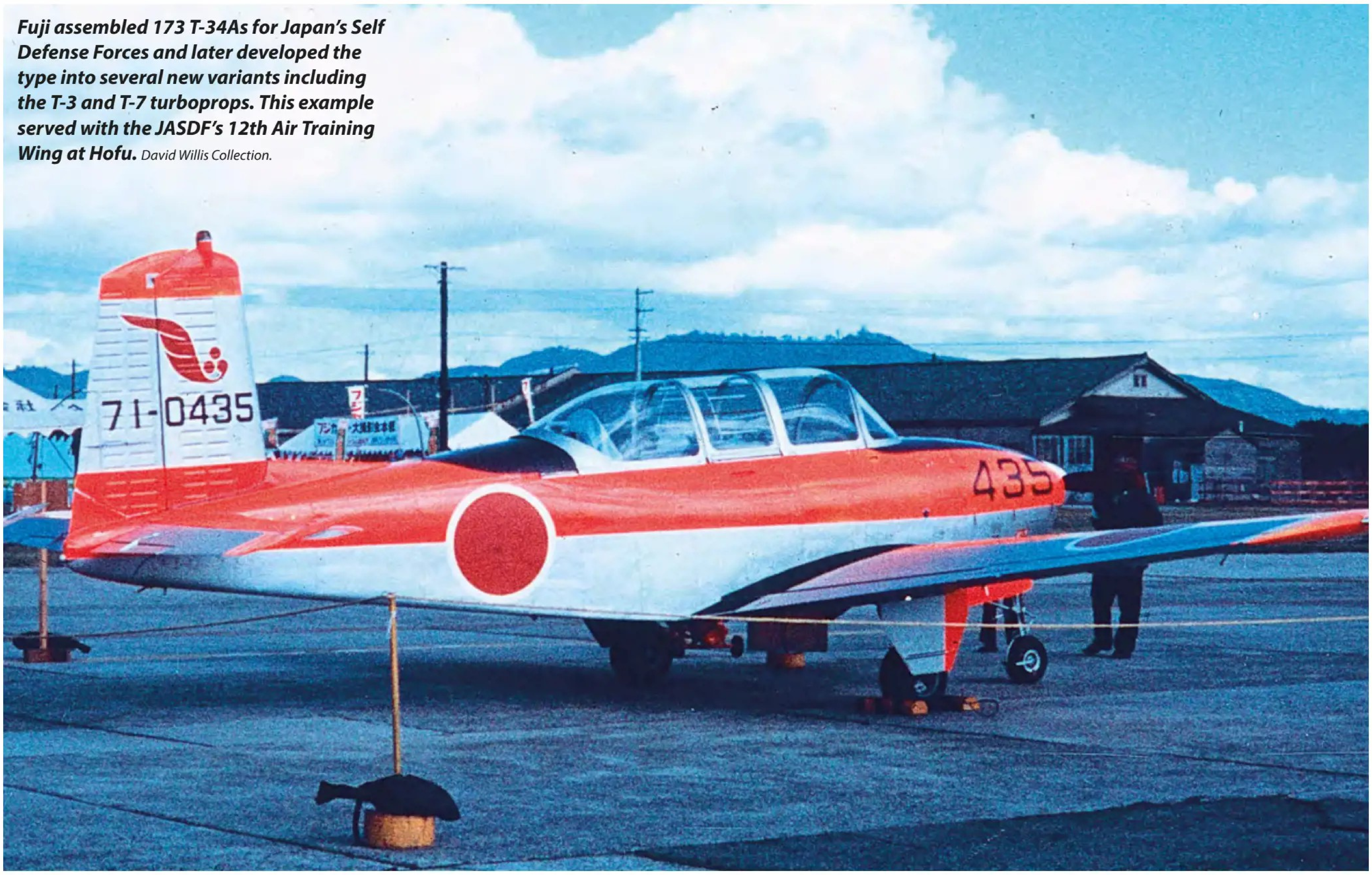
The T-34 was particularly popular in South America. Chile was the first customer, taking 66 as the B-45 Mentor from 1953. Colombia acquired 32, El Salvador, three; Mexico, four; and Venezuela 34. Uruguay supplied 11 to Bolivia in 2000, adding to eight ex-Venezuelan examples.

Following 19 Beech-built T-34s supplied from 1957, Argentina's Fábrica Militar de Aviones (FMA) assembled 81 more from 1959. A further 15 T-34Cs were acquired for the Naval Aviation School in 1978. These were equipped with wing-mounted 7.62mm machine-guns and could carry rocket pods and light bombs. Four T-34Cs were deployed to the Falklands for light attack and reconnaissance duties. One was damaged by cannon fire from a Sea Harrier but escaped. All four were destroyed in a Special Air Service (SAS) raid on Pebble Island Airstrip.

Spain's military aviation academy used 25 T-34As from 1958-1988, donating the survivors



One of the three YT-34s that was evaluated before the type's selection in 1953 as the USAF's primary trainer.



Fuji assembled 173 T-34As for Japan's Self Defense Forces and later developed the type into several new variants including the T-3 and T-7 turboprops. This example served with the JASDF's 12th Air Training Wing at Hofu. *David Willis Collection.*

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Fuji assembled 173 T-34As for Japan's Self Defense Forces and later developed the type into several new variants including the T-3 and T-7 turboprops. This example served with the JASDF's 12th Air Training Wing at Hofu. *David Willis Collection.*

to Uruguay. Taiwan's Air Force Academy at Gangshan received 44 T-34Cs in the mid-1990s and they remain in use as primary trainers.

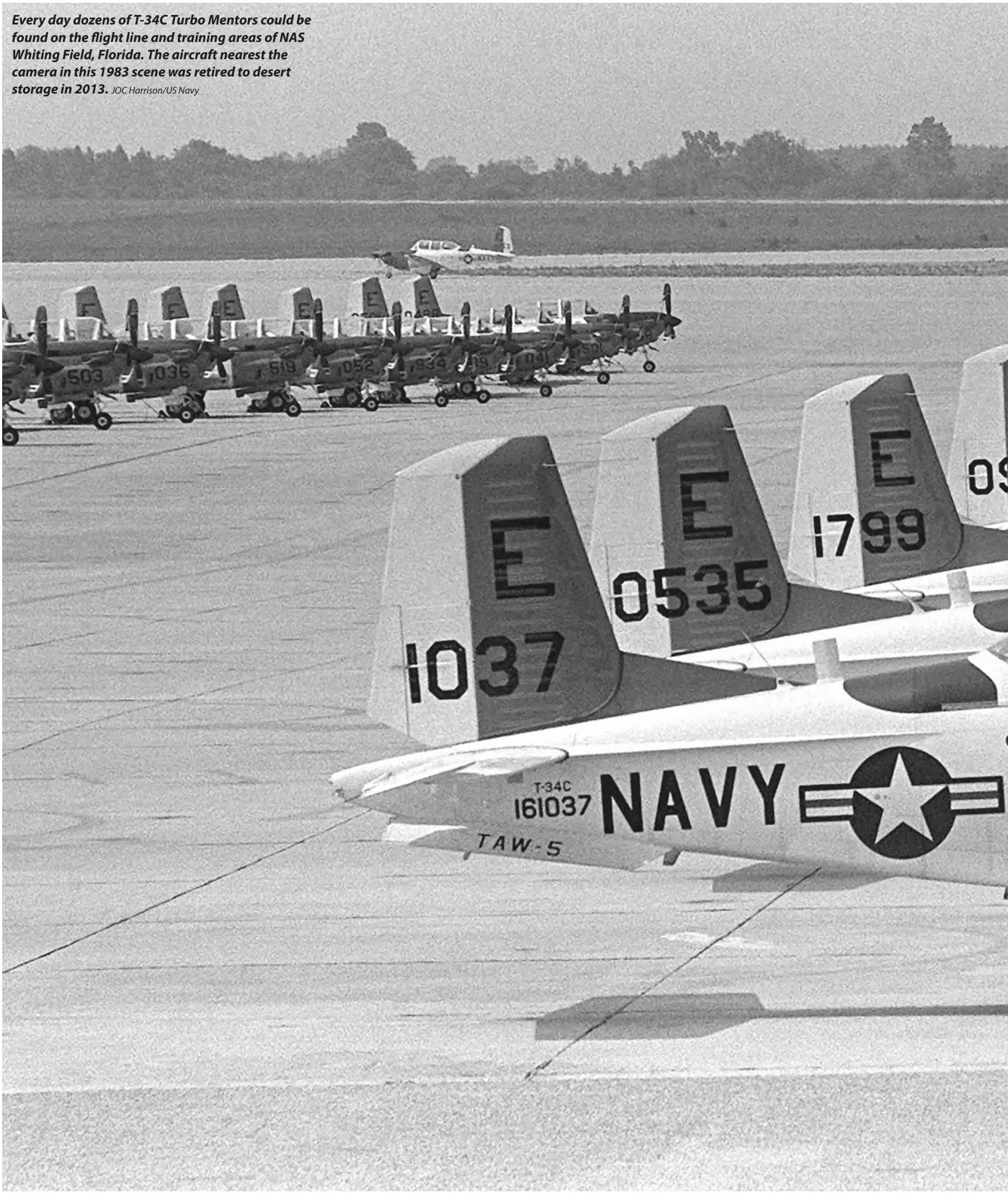
Work on an improved version to replace the T-34A and T-38 began in 1973, with the first of two YT-34C Turbo Mentors powered by PT6A-25 turboprops flown on 21 September. The engine was derated from 715shp (533kW) to 400shp (298kW). This preserved engine life and reduced maintenance effort while proving more than adequate power for student aviators. The wingspan was slightly increased and the tail fin enlarged. As with the T-34A/B there were no ejection seats and the instructor and student wore parachutes. The USN ordered the first of 352 T-34Cs in April 1975 and the last was delivered in April 1990. They were operated primarily by VT-2, VT-3 and VT-6 at Whiting Field, Florida and a few other Navy and Marine units. In Navy service the Turbo Mentor was nicknamed the 'Weenie' or the 'Tormentor'. To replace T-28s, the US Army received six T-34Cs from 1987. They were used for airspeed calibration training and as chase aircraft for tests of new Army aircraft. NASA's various T-34As and Cs mainly operated as safety chase aircraft for test flights of UAVs. Some surplus T-34Cs have been supplied to the US Forest Service as spotter aircraft for larger firebombers.

Beechcraft T-6Cs have replaced most of the US Navy's T-34Cs, with around 15 Turbo Mentors still in service with various units in 2024 and two with the Marine Corps.

The T-34C was also widely exported, operators including Ecuador (20), Gabon (four), Indonesia (25), Morocco (12), Taiwan (40). The Argentine Navy still operates ten, three of them as a historic flight, and the Peruvian Navy seven. ■

Beechcraft T-34C Turbo Mentor

Crew: Two
Length: 28ft 8in (8.74m)
Wingspan: 33ft 3in (10.13m)
Height: 9ft 11in (3.02m)
Empty weight: 2,960lb (1,342kg)
Max T/O weight: 4,325lb (1,962kg)
Powerplant: One Pratt & Whitney Canada PT6A-25 turboprop engine rated at 400shp (298kW)
Max speed: 246mph (396km/h)
Service ceiling: 30,000ft (9,144m)
Range: 708 miles (1,139km)
Armament: Provision for two 7.62mm machine-guns, gun pods, rocket pods and light bombs



Every day dozens of T-34C Turbo Mentors could be found on the flight line and training areas of NAS Whiting Field, Florida. The aircraft nearest the camera in this 1983 scene was retired to desert storage in 2013. *JOC Harrison/US Navy*

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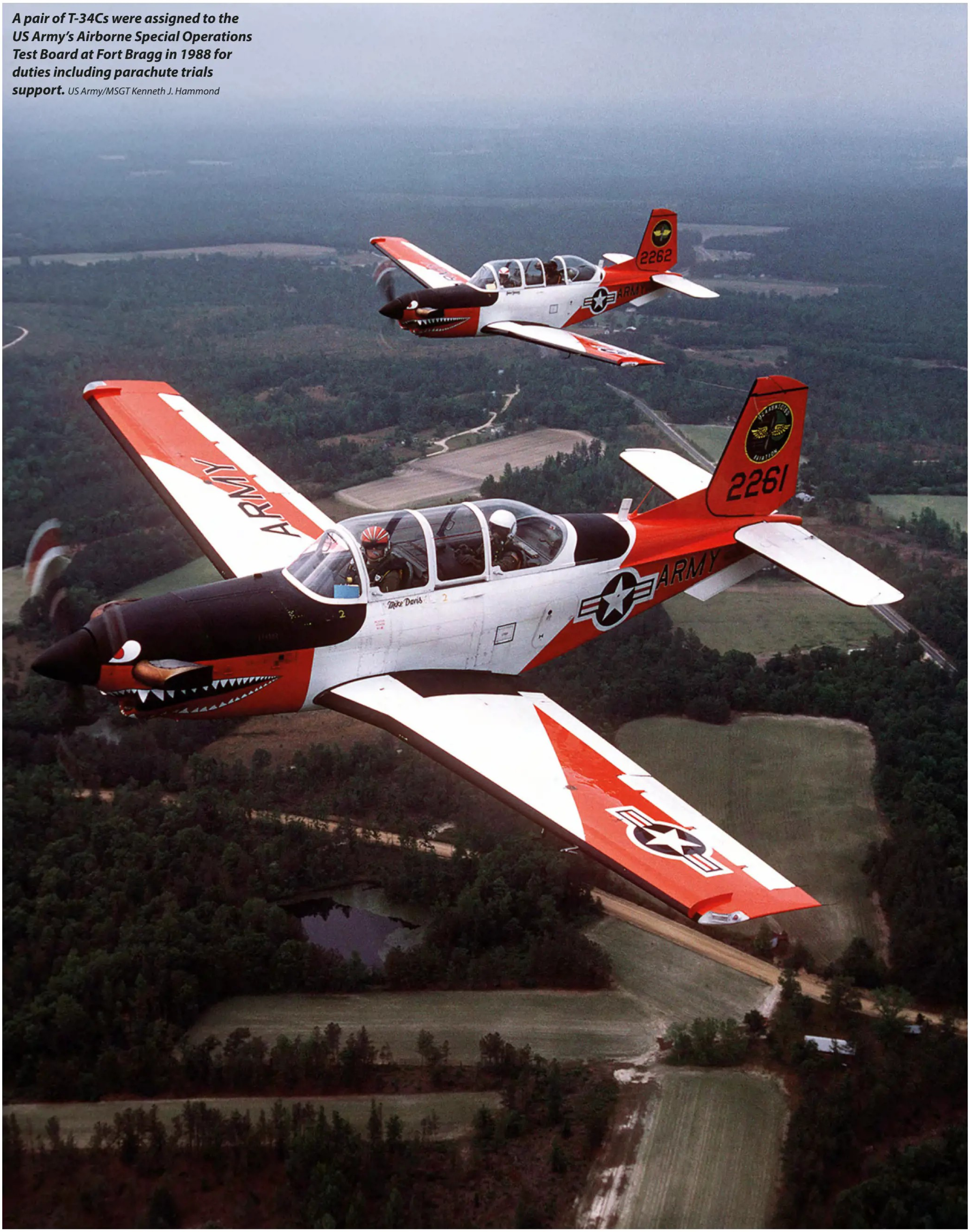
ARMY
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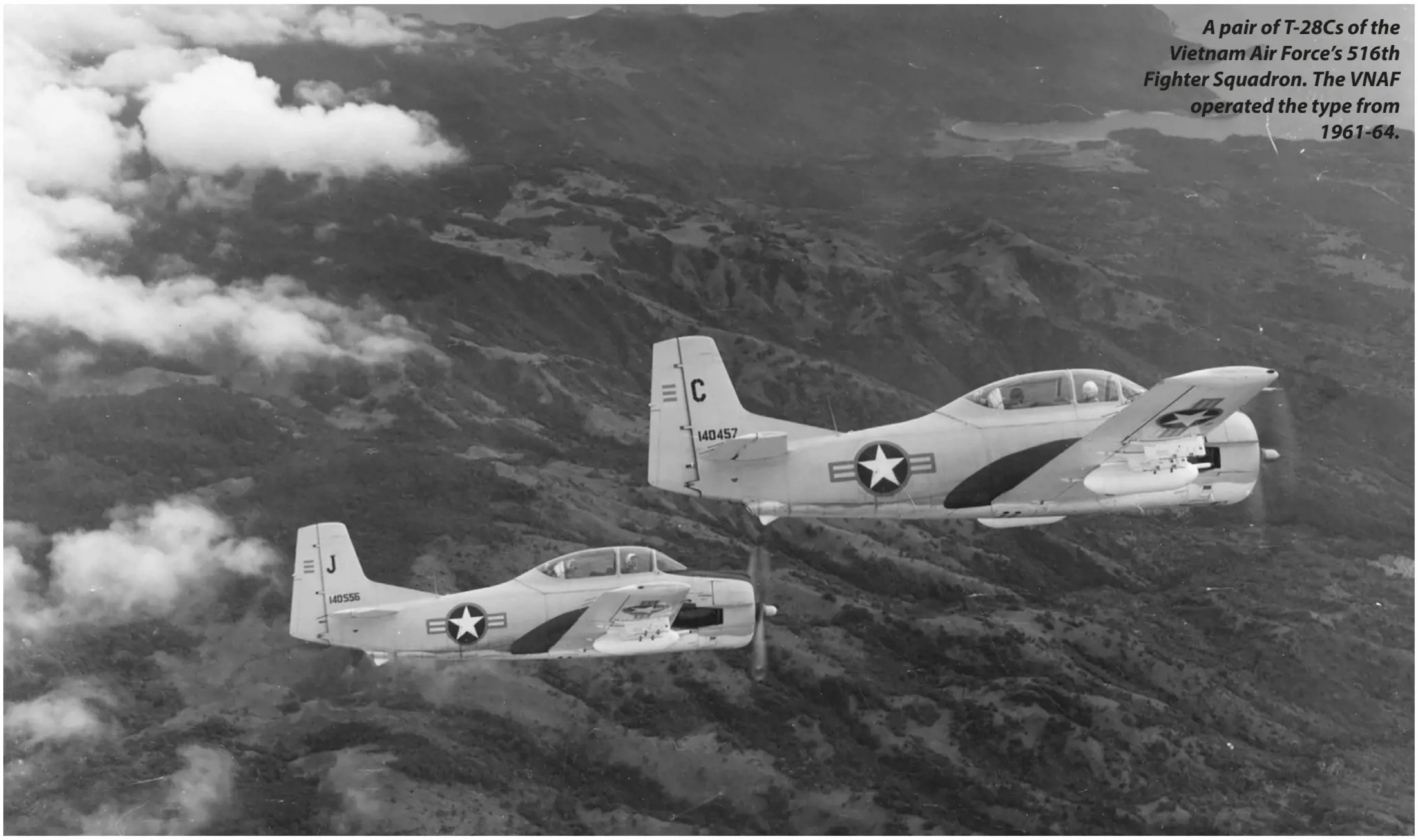
Mike Davis

A pair of T-34Cs were assigned to the US Army's Airborne Special Operations Test Board at Fort Bragg in 1988 for duties including parachute trials support. *US Army/MSGT Kenneth J. Hammond*



A pair of T-28Cs of the Vietnam Air Force's 516th Fighter Squadron. The VNAF operated the type from 1961-64.

North American T-28 Trojan

Joint Service Trainer

NAA's T-28 brought jet characteristics to basic flight training for the US Air Force and Navy. Its legacy was as a ground-attack aircraft in many of the post-war conflicts, serving some Asian air forces as late as the 1990s.

The SNJ Texan had served the US Navy well through the war, but by 1946 the Bureau of Aeronautics (BuAer) was seeking a replacement basic trainer more suitable for carrier operations. North American responded with the XSN2J-1, a larger aircraft powered by an 1,000hp (760kW) R-1830-78 Wright Cyclone radial with a three-bladed propeller. Like the SNJ, it had a tailwheel landing gear. The first of three prototypes flew on 15 February 1947 and was evaluated alongside the Fairchild XNQ-1 primary trainer. Unfortunately, the Navy changed its planned training syllabus, no longer requiring an aircraft in the SN2J-1 or NQ-1's' categories.

In 1947 the new US Air Force also issued a specification for a T-6 replacement with an 800hp (597kW) Wright R-1300 engine and a two-bladed Aero Products propeller. With jets on the horizon, all of which had tricycle undercarriage, this configuration was also specified. Douglas offered the XT-30 with its engine buried in the mid-fuselage, but this never left the drawing board. North American dusted off the XSN2J-1 design, replaced the landing gear with a tricycle arrangement incorporating a steerable nose wheel. The canopy was enlarged, but the basic structure was mostly unchanged. The cockpit layout was based on that of NAA's F-86A Sabre. In May 1948 the XBT-28 (BT for Basic Trainer) was selected as the USAF's new trainer, well before its first flight (now as the XT-28) on 26 September 1949 with J.L. 'Skip' Ziegler at the controls of 48-1371.

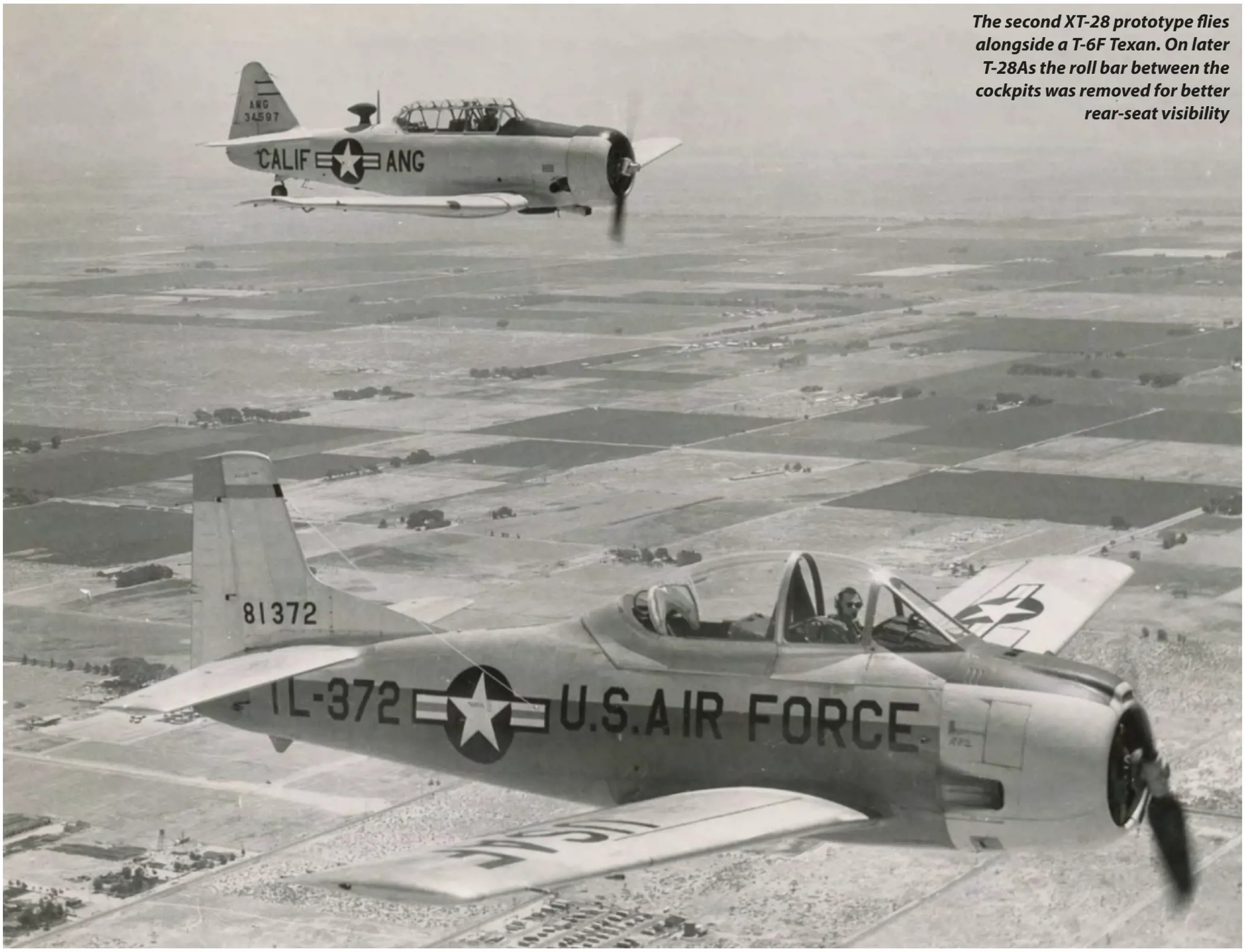
Flight testing proved satisfactory and a contract for 266 designated as the T-28A was signed in late 1949. Deliveries of the first aircraft began to Air Training Command in April 1950.

Production aircraft differed little from the prototypes except for deletion of the ventral airbrake.

With the specified engine and extra equipment such as radios, the T-28A was a bit underpowered, particularly on take-off. This gave students a comparable experience to flying early jets with their less-than-instant acceleration. Later-production T-28As had a slightly shallower canopy with no roll bar in the cockpit and increased fuel tankage in the wings. For training purposes light bombs or gun pods (two 0.30in or one 0.50in) could be carried on underwing hardpoints. NAA factories at Inglewood and Downey California

North American T-28D Trojan

Crew: Two
Length: 33ft 0in (10.06m)
Wingspan: 40ft 1in (12.22m)
Height: 12ft 8in (3.86m)
Empty weight: 6,424lb (2,914kg)
Max T/O weight: 8,500lb (3,856kg)
Powerplant: One Wright R-1820-86 Cyclone 14-cylinder radial piston engine rated at 1,425hp (1,063kW)
Max speed: 343mph (553km/h)
Service ceiling: 35,500lb (10,820kg)
Range: 1,060 miles (1,706km)
Armament: Payload 1,200lb (544kg), including rockets, gun pods, bombs and fragmentation bombs.



The second XT-28 prototype flies alongside a T-6F Texan. On later T-28As the roll bar between the cockpits was removed for better rear-seat visibility

and Dallas, Texas produced 1,194 T-28As up to 1953.

Regular USAF service was fairly brief. With the Beech T-34A supplanting it in Air Training Command by 1956. At the same time, however, the Air National Guard's F-51 Mustangs were reaching the end of their useful lives before jet fighter replacements were available. As an interim measure four ANG units were re-equipped with T-28As between 1955 and 1958.

Under mutual defence assistance programmes, used T-28As were exported to Argentina, the Dominican Republic, Ecuador, Honduras, South Korea, Mexico, Nicaragua, the Philippines and Saudi Arabia. Some of these were armed for internal security and counterinsurgency roles and saw action. Nicaragua's T-28As battled Sandinista forces in the 1970s.

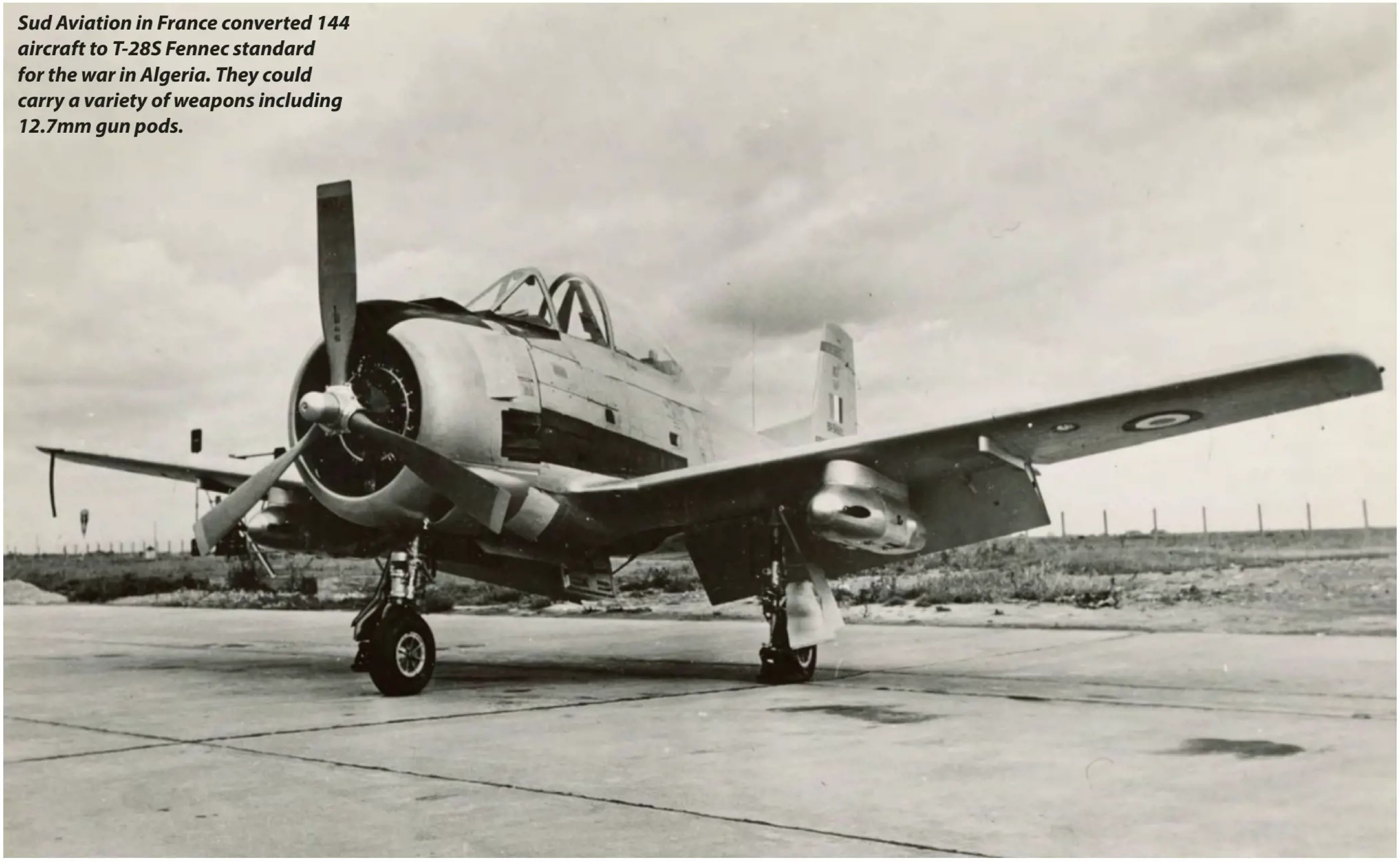
The US Navy returned to take another look at the T-28 in 1952, partly as the Pentagon was trying to save money by encouraging common equipment where possible. The Navy's version of course varied from the Air Force's, not least in having a 1,425hp (1,063kW) Wright R-1820-86A engine and a three-bladed propeller. It also had a ventral speed brake, smaller nose wheel and an arrestor hook. The canopy became two sliding sections, a format also adopted on later T-28As.

The 489 T-28Bs and 299 T-28Cs, which the Navy named the Trojan, were built at Columbus, Ohio. The latter variant had an arrestor hook and both trained thousands of US Naval aviators up to the point of their first carrier landings from 1955 until 1984.

The war in Algeria was depleting France's stocks of T-6s and T-6 pilots by 1959 when Paris sought a replacement and requested 148 T-28As from US stocks. The A model was underpowered, so the French contracted Pacific Airmotive to replace the engines with 1,425hp R-1820-76As and install three-bladed propellers. Designated T-28S and named Fennec (desert fox), 148 were converted and supplied, reaching Algeria from August 1960. They attacked insurgent forces with bombs, 12.7mm gun pods, 2.75in and larger rockets. In two years of combat as many as 23 Fennecs were lost in action and accidents.The war was winding down and Armée de l'Air units returned to Metropolitan France in late 1962.

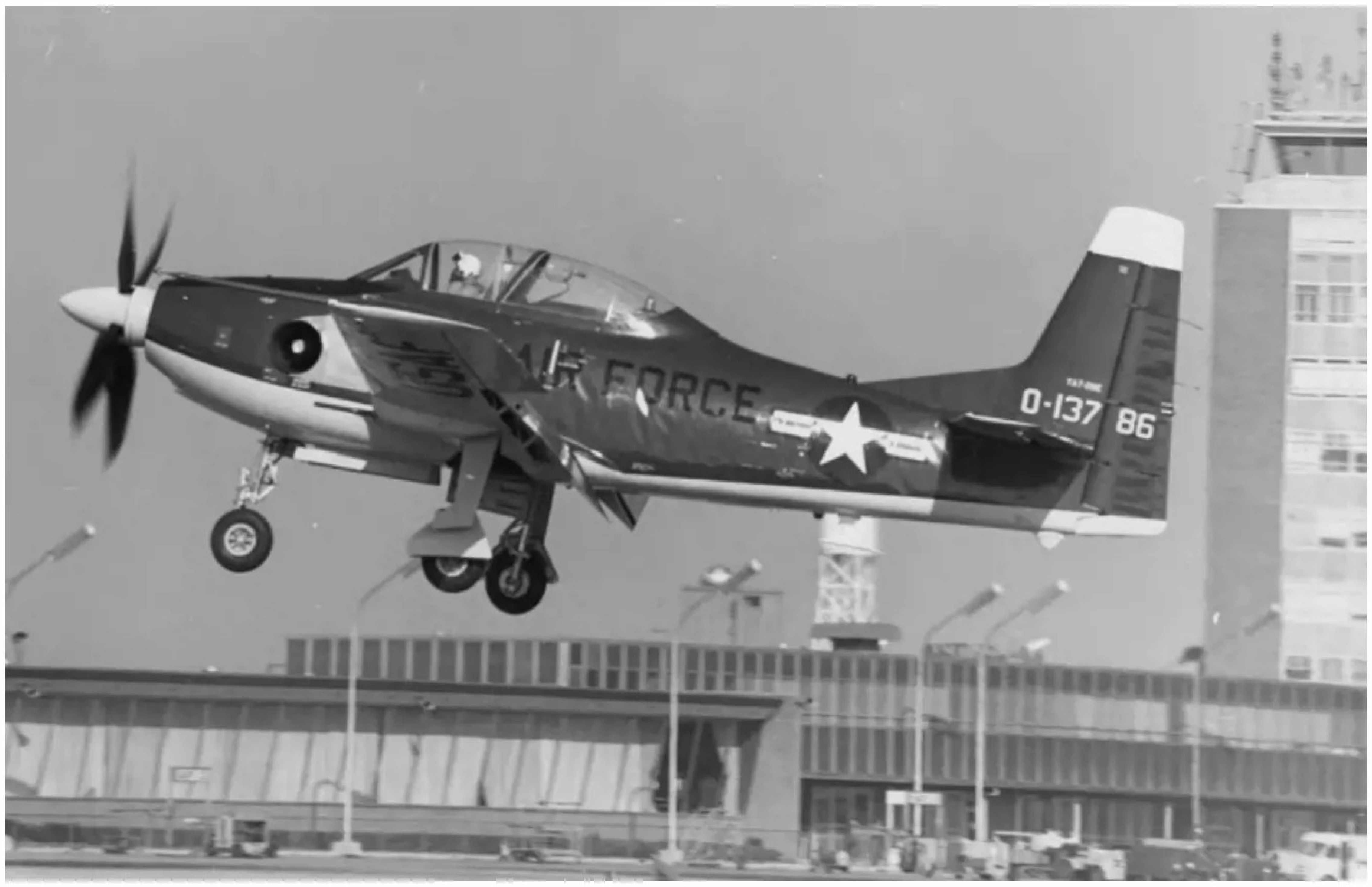
Argentina acquired 64 Fennecs from France in 1966-67. Many were fitted with arrestor hooks and used as strike aircraft from the navy's carriers between the retirement of the F4U Corsair and introduction of the A-4Q Skyhawk. At least nine were given to the Uruguayan Navy and later fitted with R-1820-82WA engines from S-2 Trackers.

In 1962, NAA produced the T-28D by converting T-28As and some Bs and Cs with two underwing gun mounts and six weapons pylons, two of which were plumbed for external fuel tanks. They had R-1820-56S engines and three-bladed propellers. Cockpit armour and armoured seatbacks and headrests were installed. Columbus produced 321 T-28Ds and Fairchild Republic a further 72, which were


Sud Aviation in France converted 144 aircraft to T-28S Fennec standard for the war in Algeria. They could carry a variety of weapons including 12.7mm gun pods.

designated AT-28Ds. These were purchased by the USAF for supply under mutual aid, mostly to governments in developing countries fighting communist or nationalist insurgencies.

Under project Farm Gate, USAF 'advisors' flew combat missions in South Vietnam even before America was officially involved in the war. This was permitted as long as a Vietnamese 'observer' was in the rear seat. The T-28 would become the main attack aircraft of the Vietnamese Air Force (VNAF). Some were RT-28Bs used for reconnaissance with a camera pod. T-28s were also supplied to the Laotian and Khmer (Cambodian) Air Forces. In 1964 a Khmer AF T-28D shot down a VNAF O-1 Bird Dog that entered Cambodian airspace. Most of the Khmer T-28s were destroyed in a 1971 sapper attack on their base.

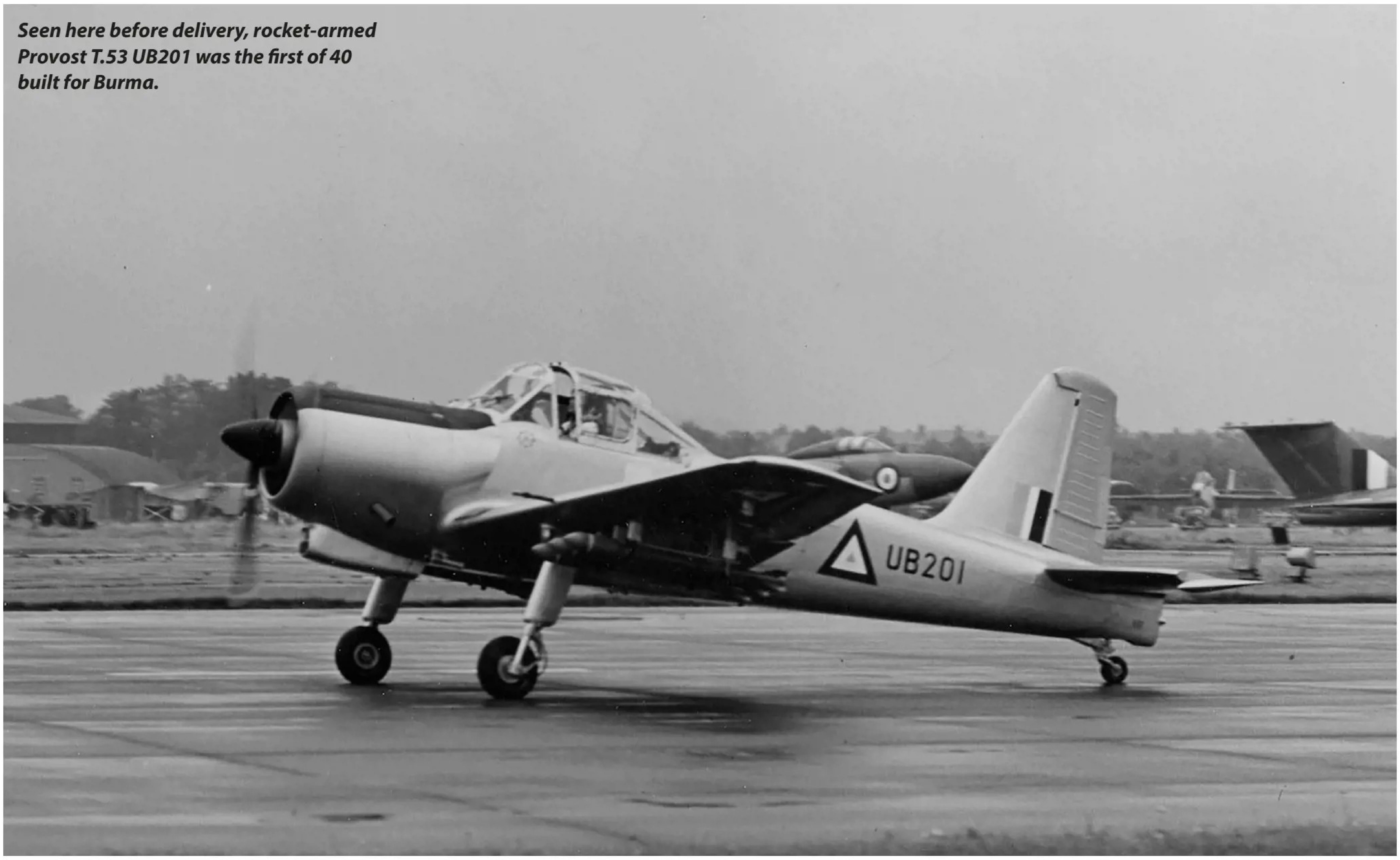


The first YAT-28E 'Turbo Trojan' flew in February 1963. The third prototype, seen here, had an extended fin and ejection seats.

Philippines Air Force Trojans remained in service into the 1990s. In December 1989 rebel PAF officers bombed the presidential palace during a coup attempt against President Corazin Aquino. Loyalist F-5s reportedly destroyed several T-28s. The last four aircraft, known locally as 'Tora-Toras' flew missions against rebels in the north of the country until their retirement in 1992. They used mixed loads of 500lb and 260lb bombs, cluster bombs and gun pods.

The YAT-28E was a dedicated counterinsurgency (COIN) variant powered by a 2,450hp (1,828kW) Lycoming T55 turboprop and armed with two 0.50in machine-guns and up to 6,000lb (2,700kg) of weapons on 12 underwing hardpoints. Three were built, the third one with ejection seats after the loss of the first. The USAF project was canceled in 1965. The Navy tested it in 1966 but found it too 'hot' for a trainer.

Taiwan continued with the turboprop Trojan concept, creating the AIDC T-CH-1 by fitting 1,405shp (1,048kW) Lycoming T53-L-701 engines to T-28As. Production of 50 ran from 1976-81 and they served as basic trainers, then weapons trainers and finally coastal patrol duties as late 1998. ■



Seen here before delivery, rocket-armed Provost T.53 UB201 was the first of 40 built for Burma.

Percival Provost

Piston Swansong

The 'Steam Provost' was the last of a long line of RAF piston trainers and was later developed into a jet. Several smaller air arms found it to be a useful counter-insurgency platform.

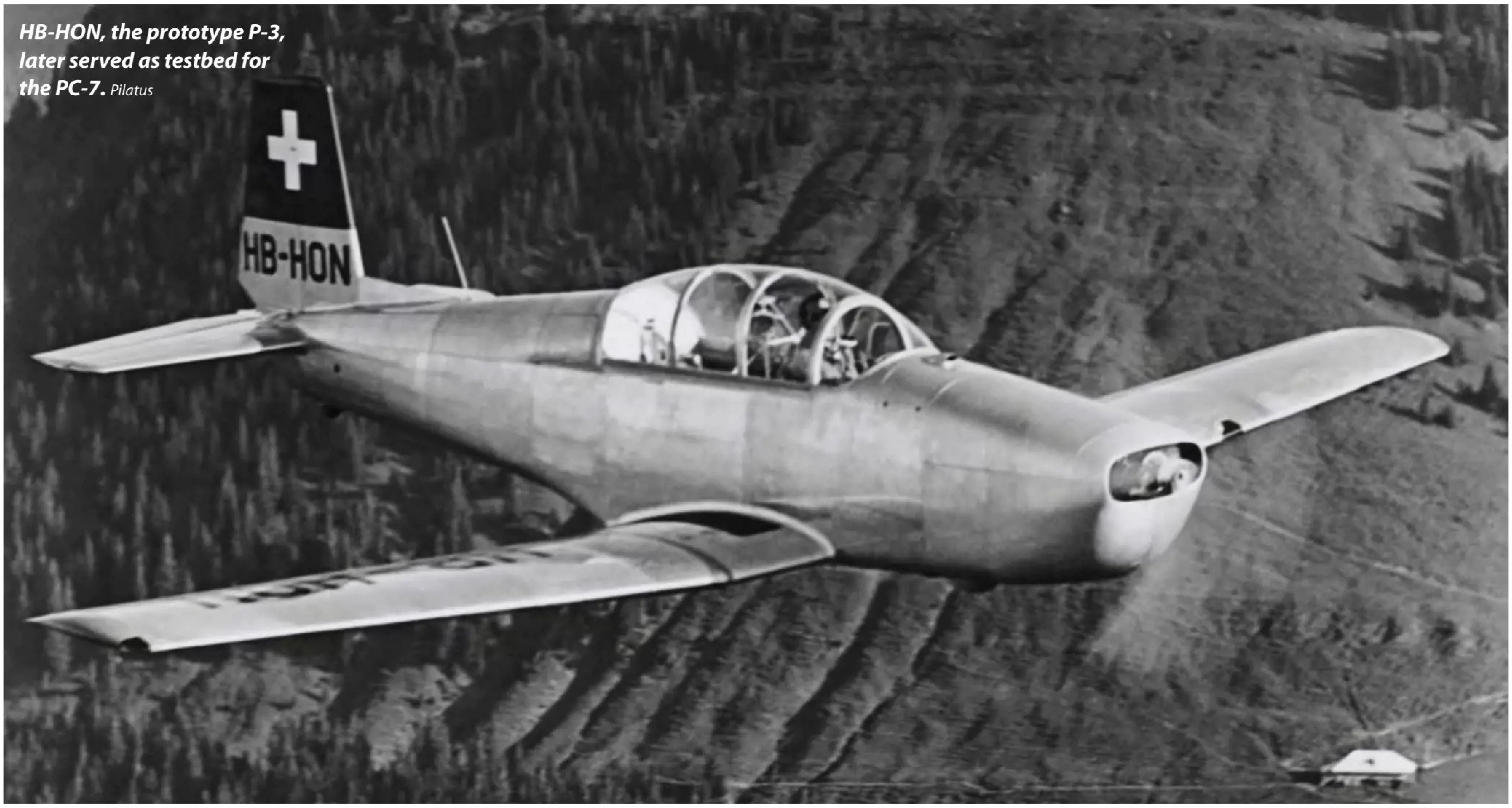
Percival's chief test pilot 'Dickie' Wheldon conducted the maiden flight of the prototype, WE522, at Luton on 23 February 1950. This was powered by 385 hp (287 kW)Armstrong Siddeley Cheetah 18 engine, but the third prototype and subsequent aircraft used the Alvis Leonides engine. The Provost replaced Percival's own Prentice which taught pilots basics before they went on to the Harvard. Like the Prentice it had side-by-side seating and a fixed landing gear, but it was faster and aerobatic.

The Provost T.1 entered service in 1953 at Ternhill and 387 were built for the RAF, plus another 84 for export customers.The RAF had retired most Provosts by 1960, although the last examples persisted until late 1969. Armed versions were sold to several air arms. The Royal Rhodesian Air Force took four T.51 trainers in 1953, followed by 12 armed T.52s in 1955. They served with No.4 Squadron at Thornhill with a detachment at Wankie and from 1967 engaged guerrilla forces making incursions from Zambia. Nine more Provosts were acquired covertly in the 1970s. By 1976 they had been replaced by Cessna 337Gs and relegated to training.

In 1959 the Sultan of Oman's Air Force was formed, its offensive air power coming from five Provost T.52s. These were flown by contracted pilots or pilots seconded from the RAF. The operating unit was No. 1 Squadron, SOAF, initially at Muscat, then Salahah, and they flew ground attack missions in the early years of the Dhofar conflict, which began in 1965, The Provost was the first equipment of the Sudanese Air Force, formed in 1957 with four T.53s and later five ex-RAF aircraft. From 1958 the Union of Burma Air Force (UBAF) purchased a total of 40 T.53s, which operated from Meiktila and from numerous bush strips in the fight against Chinese Nationalists and other insurgent groups in the north of the country, replacing Spitfires and Seafires in this role. The Royal Iraqi Air Force took delivery of 15 armed T.52s, which entered service in May 1955. The Royal Malaysian Air Force was the last export customer, taking 24 T.51s between 1961 and 1968. The Irish Air Corps operated 11 Provosts as trainers from 1954 until 1978. In several cases the 'Piston Provost' was replaced by the Jet Provost or Strikemaster. ■

Percival Provost Mk. 52

Crew: Two
Length: 28ft 8in (8.74m)
Wingspan: 35ft 2in (10.72m)
Height: 12ft 3in (3.72m)
Empty weight: 3,350lb (1,520kg)
Max T/O weight: 4,350lb (1,996kg)
Powerplant: One Alvis Leonides 126 radial piston engine rated at 550hp (410kW)
Max speed: 195mph (314km/h)
Service ceiling: 22,500ft (6,860m)
Range: 650 miles (1,043km)
Armament: two 0.303in machine guns and external carriage of two 250lb bombs or six 60lb rockets.


HB-HON, the prototype P-3, later served as testbed for the PC-7. *Pilatus*

Pilatus P-2 and P-3

Alpine Pioneers

Pilatus are one of the biggest players in in the international training aircraft scene today. They got their start making trainers for the home market.

Named after the mountain that overlooks their factory at Stans, Pilatus Fluzeugwerke AG was set up in December 1939. Pilatus' first successful design was the P-2 trainer, intended to transition Swiss Air Force pilots onto combat types such as the Messerschmitt Bf 109. The prototype flew on 27 April 1945

The first examples had Hispano engines, but Czech-made Argus V-12s became available after the end of the war. Vanes on the spinner gave automatic propeller blade pitch control, increasing the pitch as the speed increased. The P-2 actually used parts from the Bf 109, notably in the undercarriage and cockpit. There were two versions, the unarmed P-2-05 and the P-2-06 weapons trainer with a machine-gun above the nose and wing racks for light bombs and rockets.

Entering service in 1947, the last of 57 built were retired in 1981.

The prototype P-3 (HB-HON) was flown on 3 September 1953 by George Gissler. The P-3 was a conventional monoplane of all metal construction. The pilots sat in tandem under a rearwards-sliding canopy in a cockpit equipped for night and instrument flying and. It had a a laminar flow wing and was also capable of aerobatic training.

It was evaluated against the T-34A Mentor and chosen as the primary trainer for the Swiss Air Force, although only a trial batch of 12 was ordered and delivered in 1955. The plan was to standardise training up to the jet level on one type, rather than with the Jungmann primary trainer, the Bu 131 Jungmeister for aerobatics, the P-2 for instrument training, and the T-6 Texan or Morane I-3801 for tactical training. The Air Force wanted a more powerful engine to fulfil the higher-end roles, but Pilatus was reluctant to modify the design and when it ordered larger numbers, they all had the original 260hp (194kW) Lycoming.

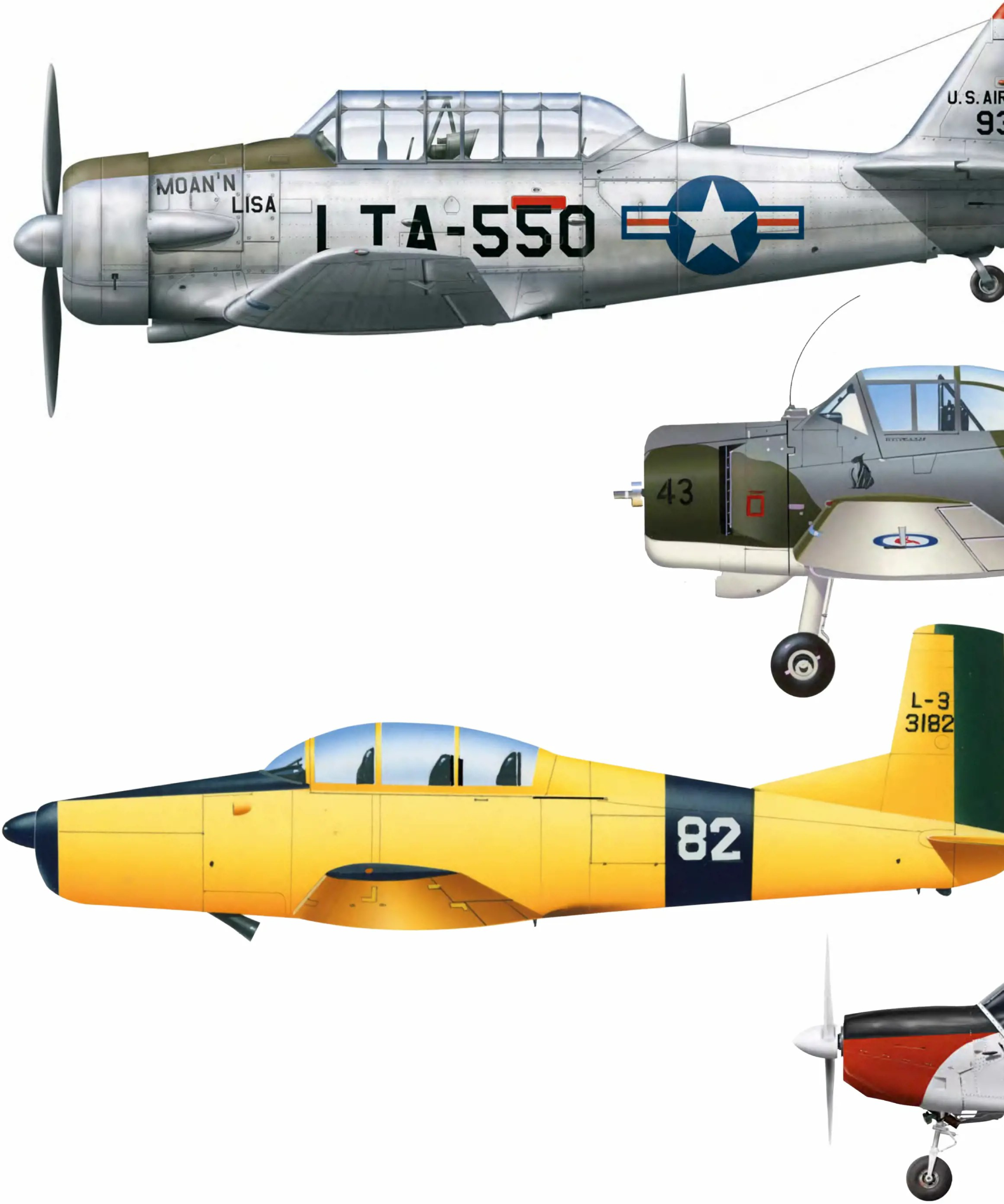
A total of 72 were built for the Swiss Air Force up to 1959, the first batch being the P-3-03 and the 60 P-3-05 with a strake was added under the rear fuselage to improve the spin characteristics

The P3-04 was a version designed for the civilian market, of which Pilatus built six without an order, while hoping for one from Swissair's pilot training centre. This never eventuated, but in 1962 the aircraft were sold to the Brazilian Navy in what was the first foreign military order for the company. They were later transferred to the Força Aérea Brasileira.

Although regarded as very pleasant to fly, P-3s were always considered a bit underpowered. In 1966 the prototype P-3 was brought out of storage and redesignated as the P-30-06. It served as the prototype PC-7. As many as 32 P-3s were sold in the USA, with a number still airworthy. ■

Pilatus P-3

Crew: Two
Length: 28ft 9in (8.75m)
Wingspan: 34ft 1in (10.40m)
Height: 10ft 0in (3.05m)
Empty weight: 2,447kg (1,110kg)
Max T/O weight: 6,173lb (2,800kg)
Powerplant: One Textron Lycoming GO-435-C2A piston engine rated at 260hp (194kW)
Max speed: 192mph (310km/h)
Service ceiling: 18,00ft (5,485m)
Range: 466 miles (750km)
Armament: None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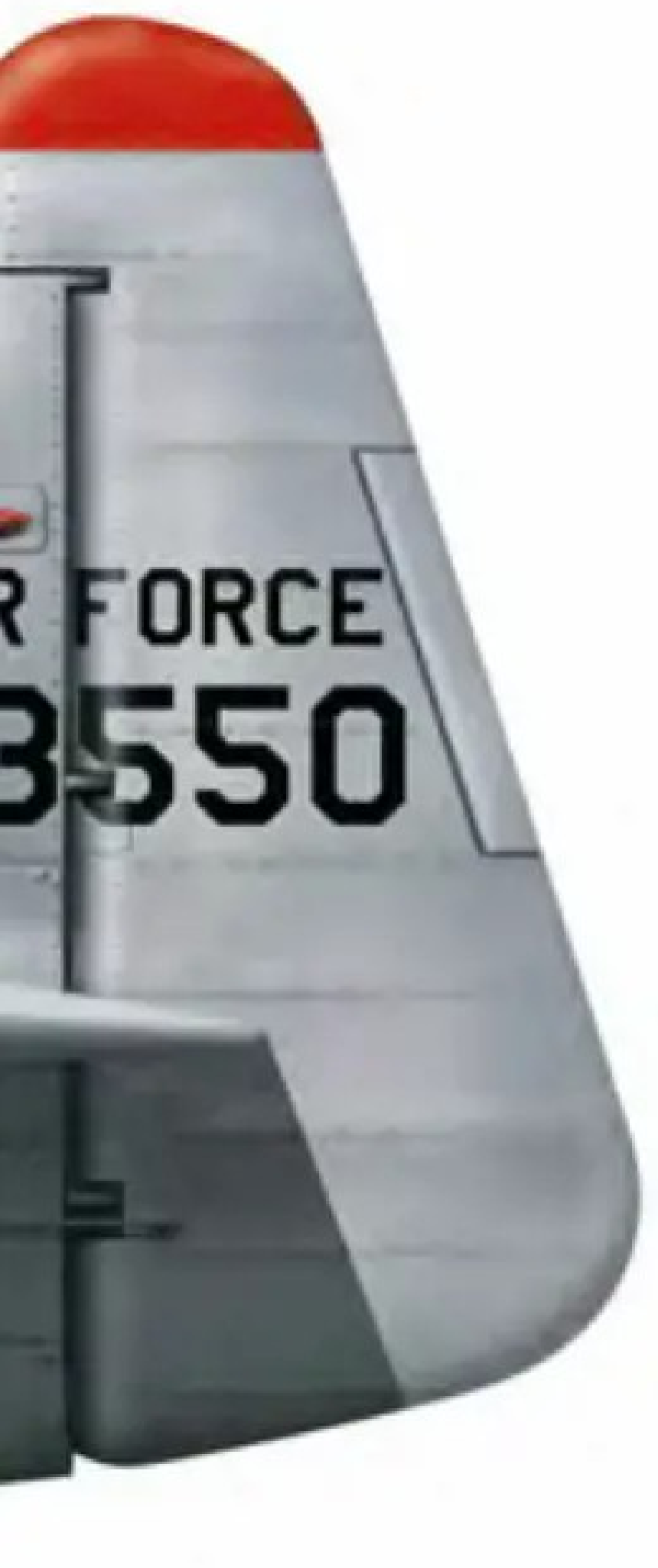
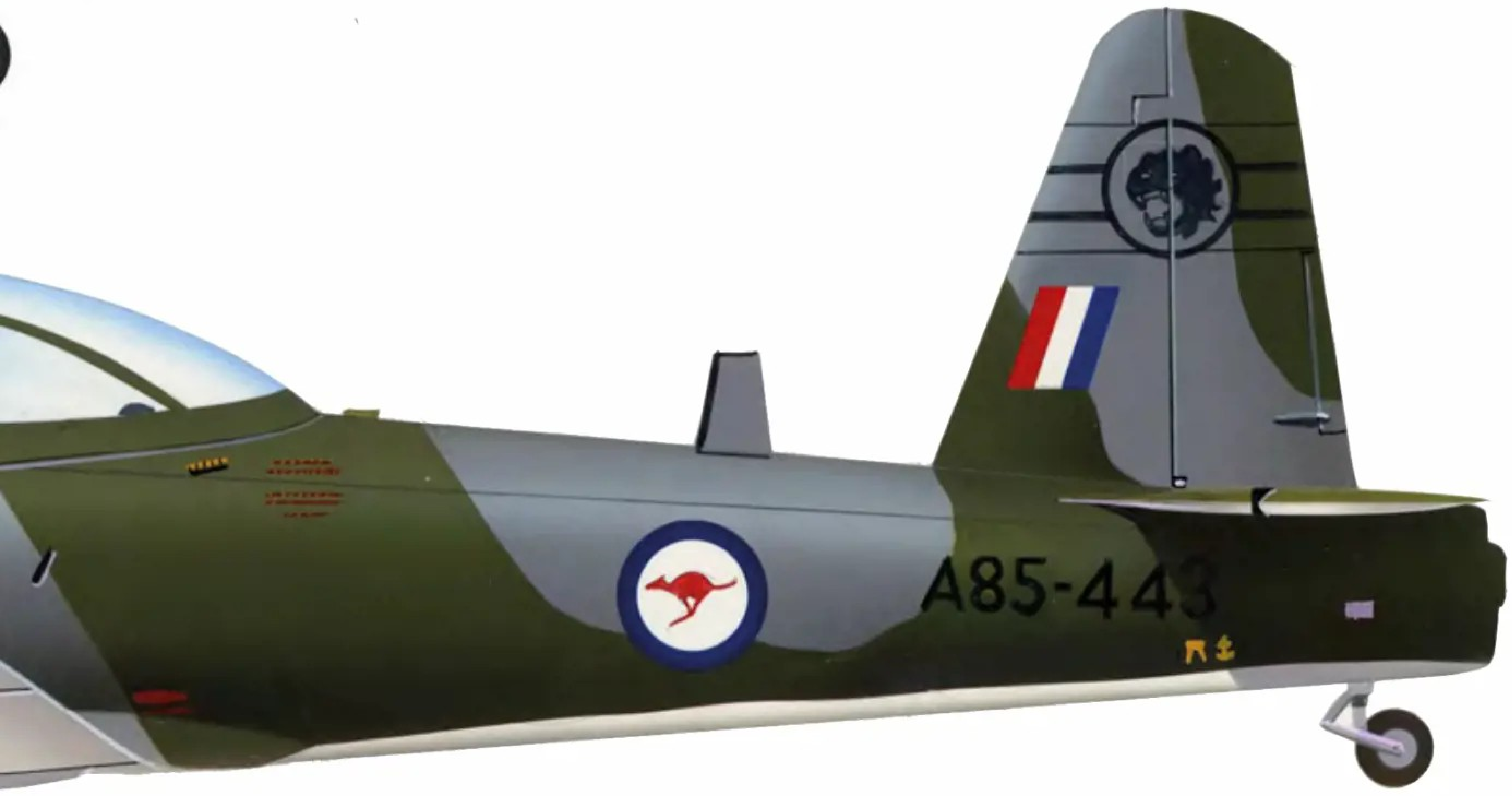
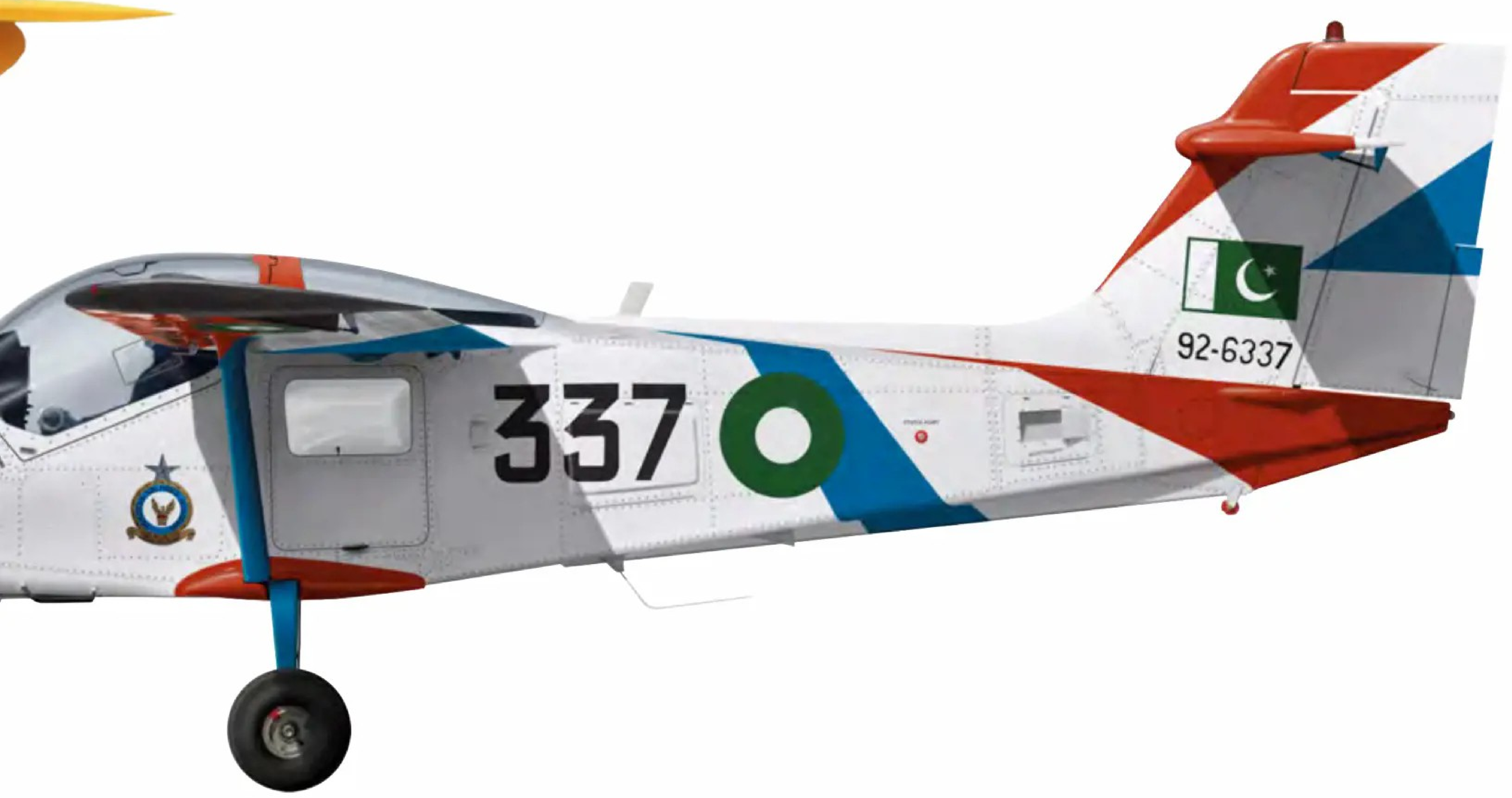






North American LT-6G Texan
49-3550, C/N 168-703
6147th Tactical Control Squadron, Airborne
Chunchon, Korea 1953

Remanufactured from an earlier Texan variant under a 1950 contract, LT-6G 'Moan'n Lisa' was based at Chunchon (K-47) in the 'Mosquito' forward air control role, which exposed pilots to heavy ground fire. The aircraft's name came from the noise made by airflow passing over the numerous bullet hole patches. Assigned to Lt Gene Risedorph, the T-6 survived the war, but appears to have suffered an accident at Chunchon in 1954.

Commonwealth CA-25 Winjeel
A85-443, C/N CA25-39
No. 76 Squadron, RAAF
RAAF Williamtown, NSW, Australia

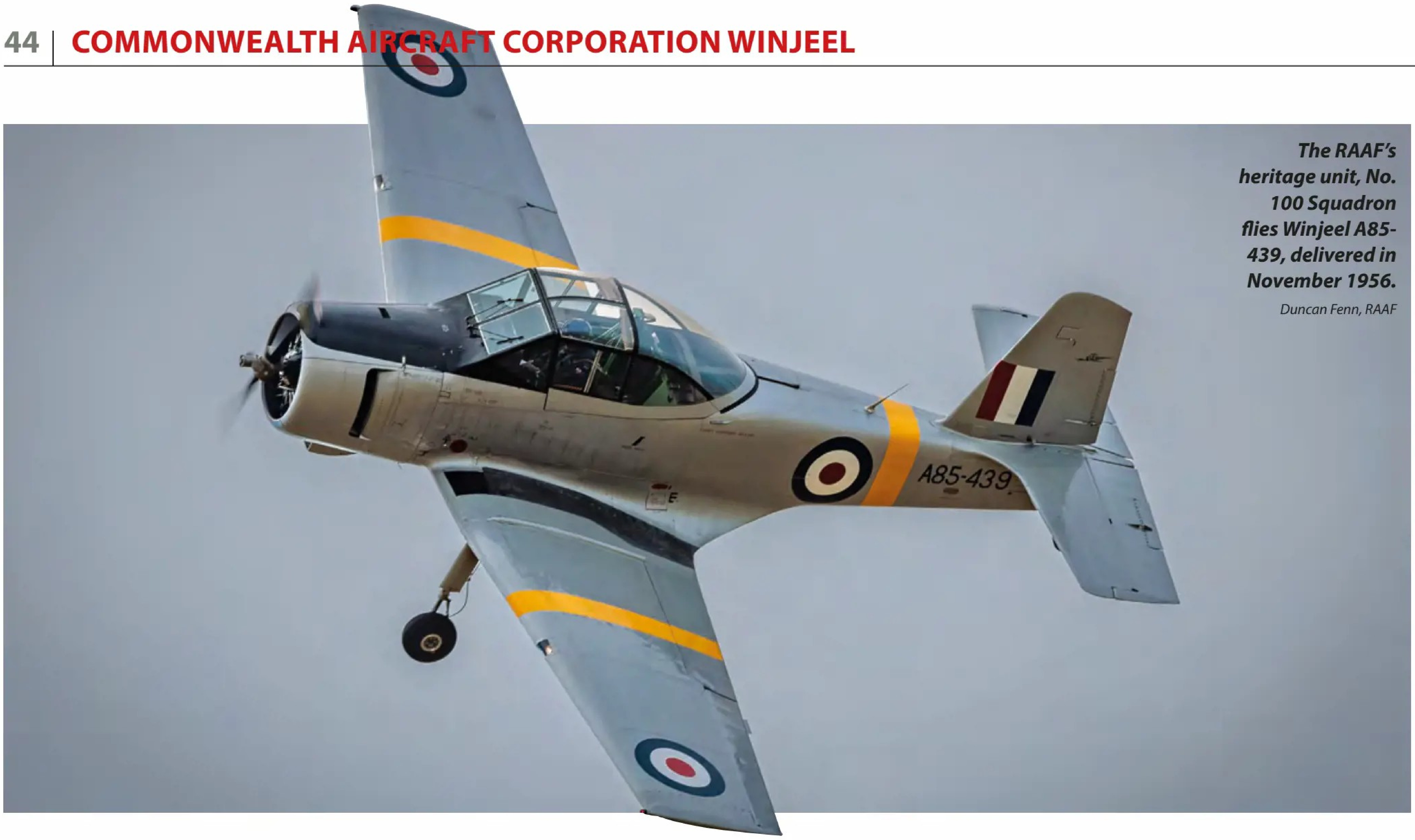
Delivered in December 1956, A85-443 served with 1BFTS. At one point it was painted in the same 'Fanta can' training scheme as used on the MB.326 and was christened 'Fancy Nancy' after a character in the soft drink's advertising. It was converted to a FAC aircraft with extra radios and flew with No. 76 Squadron until 1994. It subsequently flew on the Australian register as VH-CZE but is now VH-XRA, marked as 'A85-404'.

Pilatus P-3.04
3182, C/N 332
1st Instruction Air Squadron (AvI-1)
Aviação Naval Brasileira
São Pedro da Aldeia, Brazil, 1963

L-3 3182 was acquired by the Brazilian Navy in 1962 and flown from April 1963 until September 1965 by training squadron AvI-1 but was passed to the Força Aérea Brasileira in 1965 when the Navy was ordered to give up flying fixed-wing aircraft. It operated with the 2nd Liaison and Observation Squadron (2nd ELO) designated as an O-3. Decommissioned in March 1972, it was preserved at Parque de Material de Aeronáutica dos Afonsos before transfer to the Museu Aeroespacial in Rio de Janeiro and was restored in 2021.

PAC MFI-395 Super Mushshak
92-6337 C/N 15.337
Primary Flying Training Wing
Pakistan Air Force Academy, Risalpur, Pakistan

First noted in 2005 as 92-5337, but since re-serialled 92-6337, this is one of 29 MFI-17 Mushskaks and MFI-395 Super Mushshaks in service today with the Primary Flying Training Wing at the Pakistan Air Force's Academy at Risalpur (now PAF Academy Asghar Khan). It is one of a few with an overall white colour scheme, while most are camouflaged with high-visibility panels, and has performed aerobatic displays at air shows in the region with smoke canisters on the landing gear.


The RAAF's heritage unit, No. 100 Squadron flies Winjeel A85-439, delivered in November 1956.

Duncan Fenn, RAAF

Commonwealth Aircraft Corporation Winjeel

Young Eagle

Stemming from a 1948 requirement for a replacement for both the de Havilland Tiger Moth and CAC Wirraway, the Winjeel would fulfil the RAAF's training needs into the 1970s, but also revive the army cooperation role.

The Winjeel was very similar in size, configuration and weight to the Percival Provost with a fixed tailwheel undercarriage and side-by-side seating. There was space for a third occupant in the rear cockpit which was not just for the odd passenger, but for a second student to observe the instruction going on up front and learn from it. This concept was short-lived.

The intended powerplant was to be 420hp (313kW) R-975 Cicada engine, the first to be designed by CAC. It was based on components from the R-1830, including front and rear crankcases and cylinders, but reconditioned P&W R-985 Wasp Juniors were readily available and these were chosen for production aircraft. Clamshell cowling panels gave good access for maintenance.

The first of two CA-22s, A85-364, flew on 2 February 1951

Testing found that the aircraft was too stable and refused to spin, something regarded as pretty important in a trainer aircraft. This was cured by moving the vertical fin forward by 16in (400mm) and the engine by 7in (18cm) and subsequent aircraft were designated CA-25 Winjeel (an aboriginal word meaning 'young eagle').

A total of 62 production Winjeels were built at Fishermans Bend, Victoria; the first flying in February 1955 and the last delivered in December 1957. The Winjeel was operated from September 1955 at No. 1 Basic Flying Training School (1 BFTS) at Uranquinty, near New South Wales. In 1958 the school moved to RAAF Base Point Cook in Victoria.

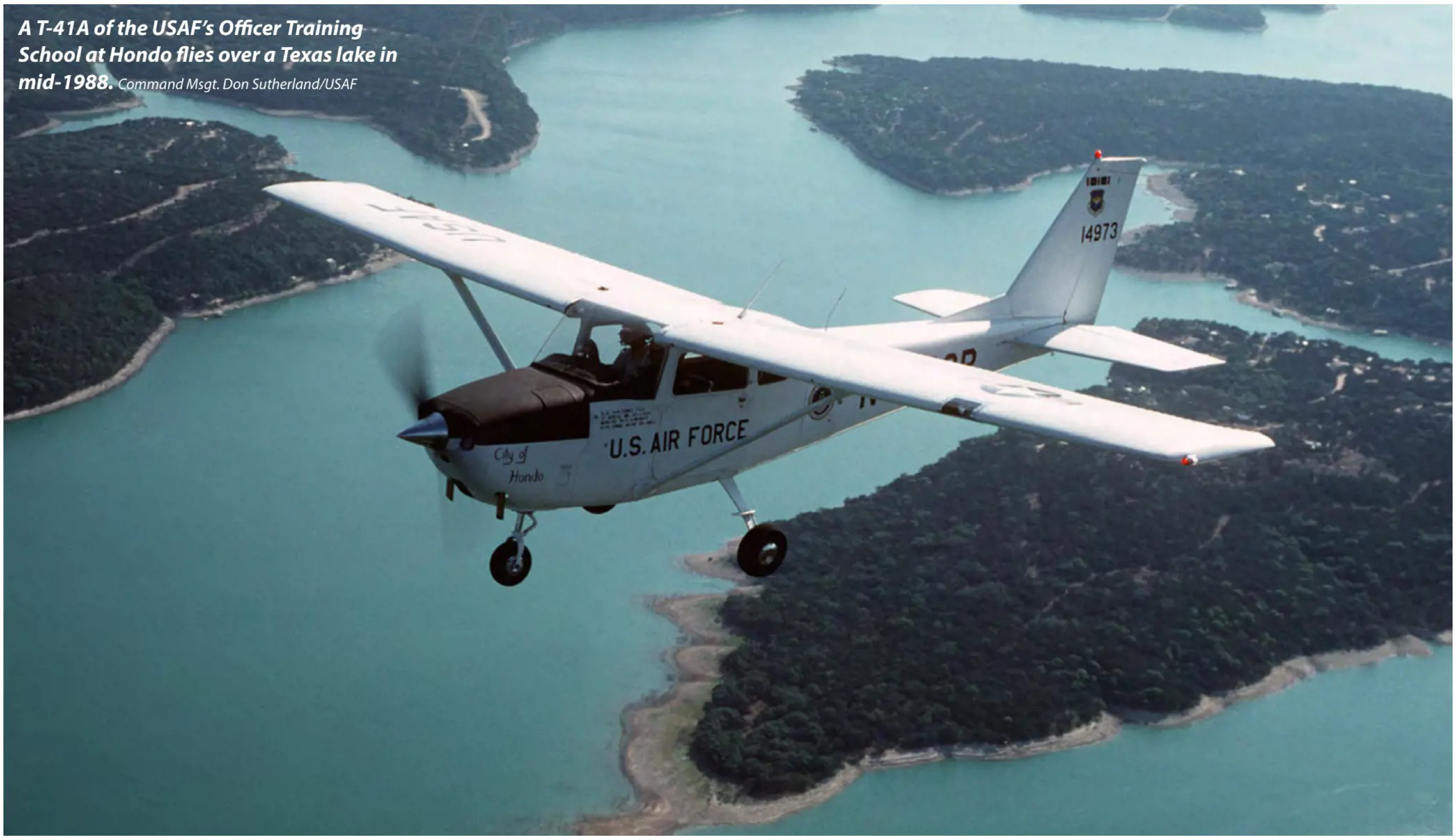
In 1968 the RAAF adopted an all-through training system using the Macchi MB326 jet, but this was unsuccessful and the Winjeel returned to service as a basic trainer until replaced by the CT/4 Airtrainer in 1975.

In 1970 several Winjeels were allocated to the independent No. 4 Forward Air Control Flight at RAAF Williamtown for FAC training. They were fitted with a dispenser under the fuselage for dropping smoke grenades to mark targets. They also had additional radios for communicating with ground troops and tactical aircraft. The unit later became No. 76 Squadron and operated the Winjeel until 1994.

Many surplus Winjeels went on to the civil market and up to 30 are airworthy today in Australia, New Zealand and the USA. ■

CA-25 Winjeel

Crew: Two or three
Length: 28ft 1in (8.56m)
Wingspan: 38ft 8in (11.78m)
Height: 9ft 1in (2.77m)
Empty weight: 3,400lb (1,542kg)
Max T/O weight: 4,340lb (1,968kg)
Powerplant: One Pratt & Whitney R-985 Wasp Junior radial piston engine rated at 450hp (336kW)
Max speed: 187mph (301km/h)
Service ceiling: 15,800ft (4,816m)
Range: 550 miles (885km)
Armament: Provision for smoke marker bombs



A T-41A of the USAF's Officer Training School at Hondo flies over a Texas lake in mid-1988. Command Msgt. Don Sutherland/USAF

Cessna T-41 Mescalero

Flight Screener

Usually thought of as a civilian aircraft, Cessna's Model 172 Skyhawk has been operated by the militaries of around 30 countries, primarily as the T-41 trainer by the USAF and US Army.

In 1961 the USAF adopted an all-jet training system using the Cessna T-37 and Northrop T-38.

This proved a mistake as many trainees 'washed out' after consuming expensive jet flying hours. To weed out the unsuitable candidates and give others a more gentle introduction to flying, the USAF decided to procure a light piston-engine aircraft for enhanced flight screening. In July 1964 the Cessna 172 was ordered off the shelf and the first of an initial batch of 170 T-41As was flown the following month. A further 34 were ordered in 1967.

Based on the Cessna R172E Skyhawk, the T-41 is an all-metal high-winged aircraft. In USAF service the two rear seats were not fitted and the streamlined wheel covers usually found on civilian Cessnas were omitted.

Most T-41As were issued to civilian flight schools under contract to the Air Force and were operated with both USAF serial numbers and FAA registrations. Some T-41As were used directly by Air Training Command's Officer Training School at Hondo Airport, Texas and the 587th FTS at Colorado Springs.

The US Army had 255 T-41B Mescaleros, delivered in 1966-67 as primary flight trainers, but also used in the general liaison role with three or four seats. They had 210hp (157kW) IO-360-D engines and constant-speed propellers. Similar to the T-41B, 52 examples of the T-41C were ordered in late 1967 for the Air Force Academy at Colorado Springs, Colorado.

The T-41D was acquired for supply under the Military Assistance Program to friendly nations, with the first going to Peru. Other military users of T-41s and C.172s included Angola, Argentina, Bolivia, Bosnia, Burkina Faso, Chile, Colombia, the Dominican Republic, Ecuador, El Salvador, Greece, Guatemala, Honduras, Indonesia, Ireland, South Korea, Liberia, Madagascar, Nicaragua, Pakistan, the Philippines, Saudi Arabia, Thailand, Trinidad and Tobago and Turkey.

Ireland's Reims-built FR172Hs had operational roles including army cooperation, security escort and border patrol.

It seems that all military operators have retired their Cessna 172 variants, but in 2015 North Korea's leader Kim Jong Un visited a machine plant producing exact copies of the C.172. At least three were seen complete and the Dear Leader took a flight in one. The unnamed knock-offs featured leading-edge slats and windscreen wipers, which are not found on official 172s. The unnamed North Korean aircraft are thought to be used for flight training and executive transport. ■

Cessna T-41A

Crew: Two
Length: 26ft 11in (8.20m)
Wingspan: 35ft 8in (10.86m)
Height: 8ft 10in (2.88m)
Empty weight: 1,245lb (565kg)
Max T/O weight: 2,300lb (1,043kg)
Powerplant: One Teledyne Continental O-300-C piston engine rated at 145hp (108kW)
Max speed: 139mph (224km)
Service ceiling: 13,100ft (3,995m)
Range: 640 miles (1,030km)
Armament: None

A notionally still operational CJ-6A of the Albanian Air Force at Kucove in September 2006. *David Willis*

Nanchang CJ-6A

Made in China

China replaced its CJ-5s, licensed copies of the Yak-18, with the CJ-6, which shared the same overall configuration but was more suitable for training jet pilots for the People's Liberation Army Air Force (PLAAF).

Work began at Shenyang in 1956. Engineers Bushi Cheng and Lin Jiahua revised the design, converting it to nosewheel configuration with an an aluminum monocoque fuselage, flush riveting and a new wing airfoil. The inner wing had the same section as the Beech T-34, while the outer wing panels had considerable dihedral. Distinctive louvres in the cowling trap engine heat to facilitate starting in Manchurian winters. Most of the systems, including engine start are powered by pneumatic systems.

The first flight of a CJ-6 prototype took place on 27 August 1958 piloted by Yinxi He and Maofan Lu. This was powered by a Russian Mikulin M-11ER engine of 145hp (108kW), which provided disappointing performance. By substituting an Ivchenco AI-14R of almost double the power, this improved enough to order it into production in 1962 at the Nanchang Aircraft Factory (now Hongdu). The CJ-6A with a Huosai-6A engine became the standard version from 1965. The CJ-6B was an armed variant of which only a small number were built for border patrol missions. They could carry two 7.62mm machine-guns, light bombs and rocket launchers. The CJ-6G or Haiyan is a civilian trainer and utility aircraft based on the CJ-6 which could be used for crop spraying or firefighting.

The westernised designation is PT-6 and several countries in the Chinese sphere of influence acquired the type: Albania (15), Bangladesh (35); Cambodia (unknown): North Korea (more than 50); Tanzania (unknown) and Zambia (12). In 2001, Sri Lanka bought ten to replace their SF.260 Warriors. The CJ-6 was in production in China as late as 2007. About 1,800 CJ-6As were built.

Its successor is the Hongdu/Yakovlev CJ-7, which first flew in 2006 and has modern features such as a glass cockpit and ejection seats, but also uses a nine-cylinder radial engine. As many as 500 may be required for the PLAAF and PLAN.

Many ex-military CJ-6s have been imported into the West as warbirds. The 'Nanchang' as it is usually known has good fuel economy, easy maintenance, plenty of baggage space and is fully aerobatic up to +6G and -3G. Examples have appeared in a wide array of colour schemes, from PLAAF markings in various degrees of authenticity to pseudo-Japanese wartime liveries. ■

Nanchang CJ-6A

Crew: Two
Length: 27ft 9in 8.46m)
Wingspan: 33ft 5in (10.18m)
Height: 10ft 8in (3.25m)
Empty weight: 2,584lb (1,172kg)
Max T/O weight: 3,128lb (1,419kg)
Powerplant: One Zhuzhou Huosai-6A radial piston engine rated at 285hp (213kW)
Max speed: 185mph (297km/h)
Service ceiling: 20,500ft (6,250m)
Range: 428 miles (690km)
Armament: None

The Bulldog served as the RAF's primary trainer from 1973-1993 and until 2000 with Air Experience Flights and University Air Squadrons. Evident in this view is how the tall canopy accommodated military pilots wearing helmets.

British Aerospace (Scottish Aviation) Bulldog

Prestwick's Pilot Trainer

Low costs, robust simplicity and flawless handling made the British Aerospace Bulldog well suited to the role of elementary flight training.

The Bulldog elementary trainer was designed by Beagle as a development of its Pup light aircraft, starting with the B.121T design and progressing to the B.123 Pup 180. It featured greater engine power, a stronger airframe, retractable landing gear, longer wings and larger rudder, but the same canopy as earlier Pups. This was eventually replaced with a bubble canopy, while a fixed gear was adopted. Interest came from Sweden, which evaluated a Pup 150 in November 1968, but wanted a much stronger aircraft, with 20 of a proposed order for 78 due to go to the army requiring short take-off and landing capabilities. These needs were incorporated into the B.125, to be powered by the Lycoming IO-360-AIC turning a Hartzell constant-speed propeller.

The first prototype (G-AXEH) was built by Beagle and first flown for 55 minutes from Shoreham, Hampshire, 19 May 1969 in the hands of Pee Wee Judge, with flight test observer David Cummings in the second seat. The aircraft received a certificate of airworthiness on 10 June 1969. Two days later Sweden ordered 58 aircraft for the Air Force, with an option for 45 for the Swedish Army. Zambia ordered eight several weeks later, while Kenya wanted five.

On 1 December 1969 Beagle was placed into receivership by the British government, its owner, although work continued on the B.125, which had been named Bulldog. Some of the company's assets passed to Scottish Aviation, which took over the Bulldog project, including the second prototype (G-AXIG), which first flew from Prestwick on 14 February 1971. It was evaluated at Boscombe Down, Wiltshire, from June 1971.

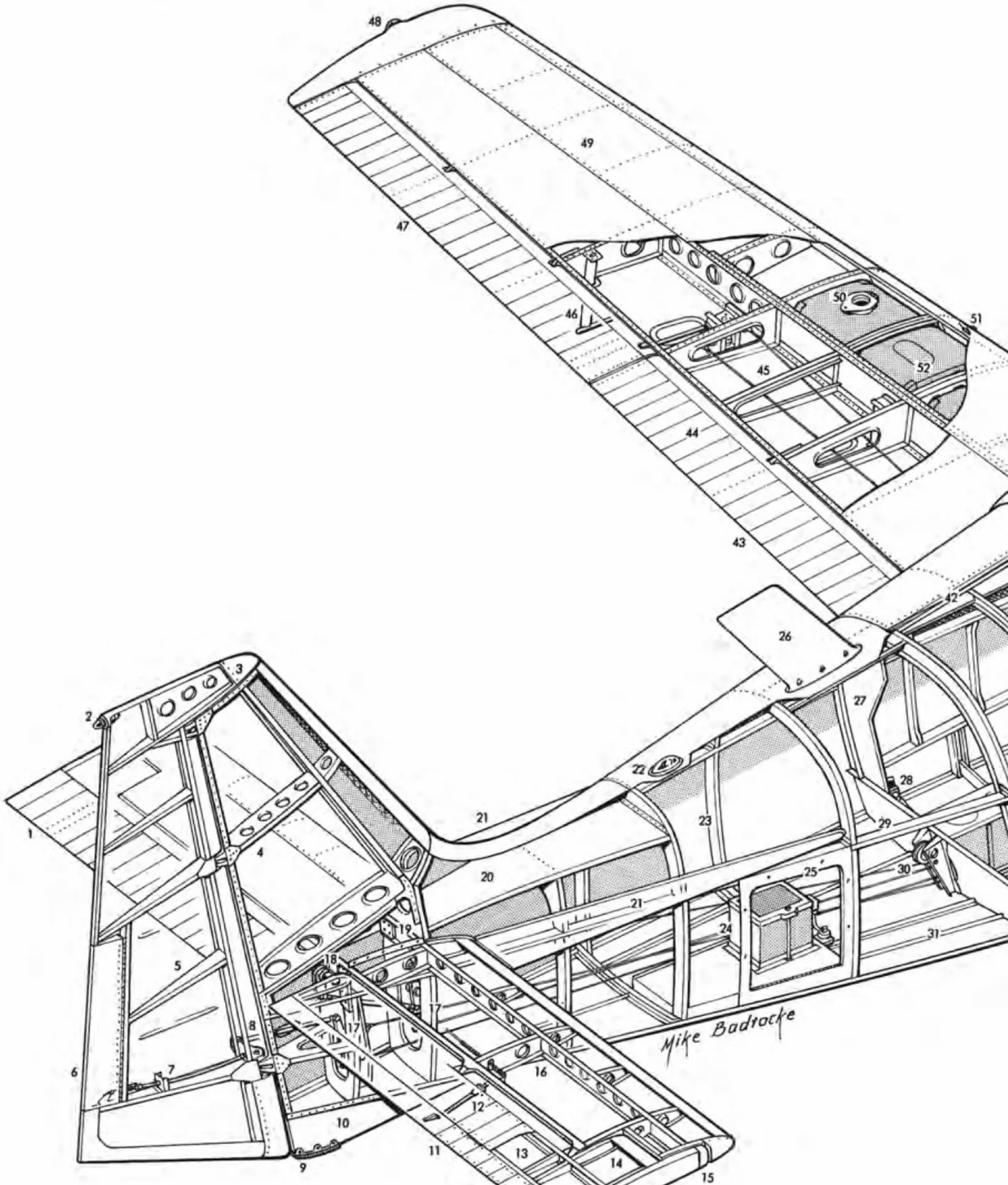
Deliveries of Bulldog 101s to Sweden began that year, the Flygvapnet taking 58 as Sk 61A and 'Bs, while the army received 20 Flp 61Cs, although in 1989 the survivors were transferred to the air force as Sk 61Cs. The fleet remained in service into 2001. Others versions of the initial model were delivered to Malaysia (15) and Kenya (five).

In 1972 the RAF ordered 130 Model 121s – as Bulldog T.1s – to replace the de Havilland Chipmunk T.10, its first making its maiden flight on 30 January 1973. During April 1973 the Central Flying School at RAF Little Rissington, Gloucestershire, became the first RAF unit to receive the aircraft, followed that June by 2 Flying Training School (FTS) at RAF Church Fenton, Yorkshire. No. 2 FTS included the Primary Flying Grading Squadron, providing student pilots with 15hrs of initial flying before they moved onto the basic training course. On 29 November 1974 the RN Elementary Flying

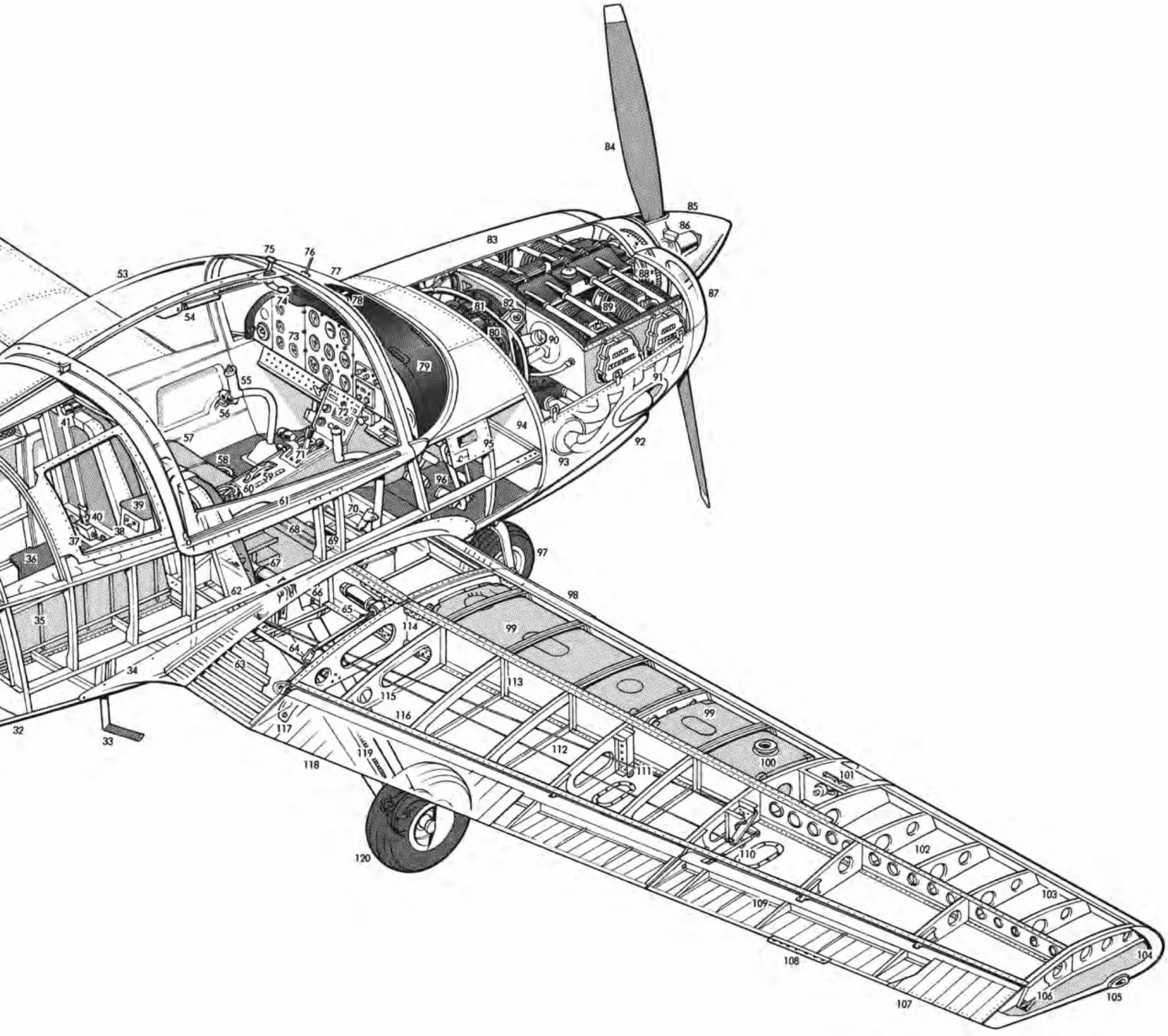
Scottish Aviation Bulldog T.1

Crew: Two
Length: 23ft 3in (7.09m)
Wingspan: 33ft 0in (10.06m)
Height: 7ft 5in (2.28m)
Empty weight: 1,430lb (649kg)
Max T/O weight: 2,238lb (1,015kg)
Powerplant: One Textron Lycoming IO-360-A1B6 piston engine, rated at 200hp (149kW)
Max speed: 150mph (241km/h)
Service ceiling: 16,000ft (4,877m)
Range: 620 miles (1,000km)
Armament: None

Scottish Aviation Bulldog T Mk.1



1 Port elevator
2 Tail navigation light
3 Rudder horn balance
4 Two-spar fin structure
5 Rudder rib structure
6 Rudder tab
7 Tab operating cable
8 Rudder hinge control
9 Tail bumper
10 Ventral fin
11 Starboard side elevator tab
12 Tab screw jack, chain operated
13 Starboard elevator
14 Elevator horn balance
15 Elevator mass balance
16 One-piece tailplane two-spar structure
17 Tailplane mounting bulkheads
18 Elevator hinge control
19 Tailplane spar bolted joint
20 Rear fuselage horizontal
21 Glass-fibre tailplane strakes
22 Anti-collision beacon
23 Fuselage frame construction
24 Battery compartment
25 Access hatch
26 UHF antenna
27 Cabin rear bulkhead
28 Ground power socket
29 Fuselage upper main longeron
30 Elevator cable pulley
31 Lower skin/stringer panel
32 Fuselage chine edge member
33 Boarding step
34 Wing root fillet fairing
35 Centre fuselage box-section keel
36 Cabin floor panelling
37 Cabin rear window
38 Headset sockets
39 Central armrest
40 Harness release
41 Roof mounted instrument light
42 Upper canopy rail
43 Port single-slotted flap
44 Integral stiffened control surface skin panels
45 Port wing rib constuction
46 Ventral pitot head
47 Port aileron
48 Port navigation light
49 Wing skin panelling
50 Fuel filler
51 Stall-warning vane
52 Port fuel tank installation, total fuel capacity 32 Im gall (145.5 litres)
53 Rearward-sliding cockpit canopy
54 Canopy jettison handle
55 Control column
56 Left-hand throttle lever
57 Student pilot's seat
58 Fuel cock
59 Elevator trim hand wheel
60 Rudder trim hand wheel
61 Sliding canopy rail
62 Fuselage lower longeron
63 Wing root walkway corrugated skin doubler
64 Flap operating link and cross-shaft
65 Flap electric motor
66 Main undercarriage leg pivot point
67 Horizontally mounted shock absorber
68 Instructor's seat
69 Underfloor fire extinguisher bottle
70 Control column linkage
71 Engine throttle, mixture control and propeller pitch control levers
72 Starter panel
73 Instrument panel
74 Internal canopy handle
75 External canopy handle
76 Outside air temperature gauge
77 Single-piece windscreen panel
78 Stand-by compass
79 Instrument panel
80 Engine accessory equipment
81 Welded steel tube engine bearer
82 Anti-vibration engine mountings
83 Detachable engine cowlings
84 Hartzell two-bladed constant-speed propeller
85 Spinner
86 Propeller hub pitch change mechanism
87 Engine cooling air intake
88 Starter ring gear
89 Avco Lycoming IO-360-A1B6 flat-four air-cooled engine
90 Oil filler, capacity 1.67 Imp gal (7.7 litres)
91 Oil cooler air intake
92 Ventral carburettor air intake
93 Exhaust silencer and cabin-heat exchanger
94 Fireproof bulkhead
95 Cockpit fresh air intake
96 Rudder pedals with hydraulic toe brakes
97 Steerable nose wheel
98 Leading-edge buffet strip
99 Port wing fuel tanks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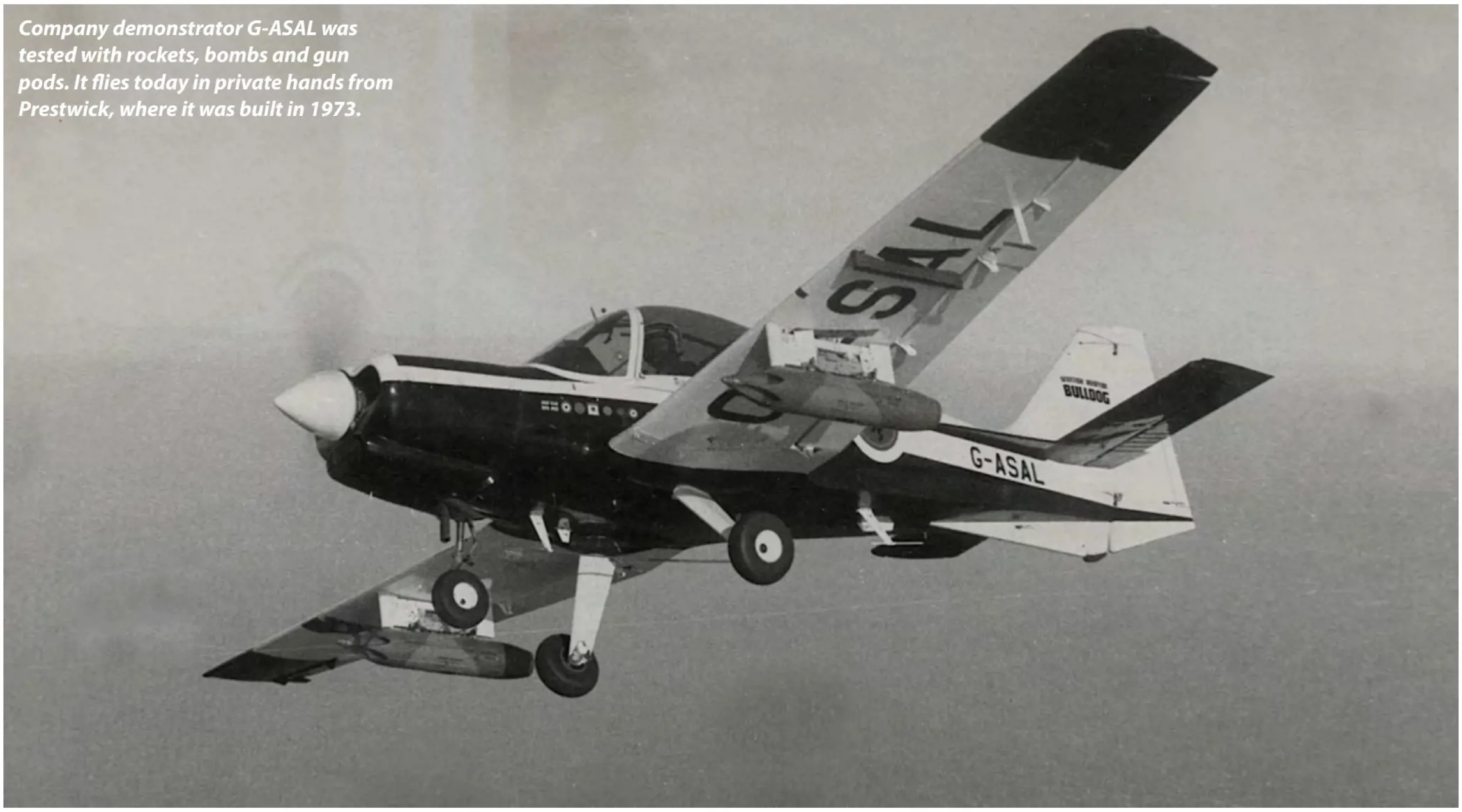
100 Port fuel fuller cap
101 Landing/taxying lights
102 Leadiing-edge ribs
103 Front spar
104 Light alloy wing tip fairing
105 Starboard navigation light
106 Ventral aileron hinge
107 Port aileron
108 Fixed tab
109 Aileron rib and leading-edge spar construction
110 Hinge control linkage
111 Wing jacking and tie-down point
112 Aileron cables
113 Main spar
114 Bolted spar root fittings
115 Starboard wing panel rib construction
116 False rear spar/control surface shroud
117 External flap hinge
118 Port single-slotted flap
119 Main undercarriage leg strut
120 Starboard main wheel with hydraulic brake



Company demonstrator G-ASAL was tested with rockets, bombs and gun pods. It flies today in private hands from Prestwick, where it was built in 1973.

Training School within 2 FTS transferred to 3 FTS at RAF Leeming, Yorkshire, allowing 2 FTS to disband on 2 December. The School moved again on 26 April 1984, relocating to Topcliffe in Yorkshire to become part of 1 FTS, but disbanded there on 8 July 1993.

Bulldog T1s were also issued to 16 university air squadrons (UAS), the London UAS at Abingdon, Oxfordshire, becoming the first such unit to receive the trainer in October 1973. The UASs merged with the Air Experience Flights in the mid-1990s, allowing the Chipmunk to be retired. Bulldogs continued to serve with the units into 2000, by when the Grob G.115E Tutor had assumed the Light Aircraft Flying Task its role. Five former RAF aircraft were sold on to the Armed Forces of Malta in 2000.

In addition, seven air arms received new Series 120 aircraft off the Prestwick production line. Six Model 122s were delivered to Ghana in July 1973, originally flying from Accra, followed by seven 122As received between December 1975 and June 1976. Around ten were reportedly serviceable in 1989. Nigeria received 37 Bulldog 123s in three batches, with 20 received in 1974, 12 in mid-1978 and the final five in late 1982. They flew with 301 Flying Training School, but support for the fleet was later withdrawn by British Aerospace after Nigeria failed to keep up payments for its SEPECAT Jaguars. A total of 13 Bulldog 125s and nine Model 125As went to Jordan, serving with 4 Squadron from 1974 until replaced by Slingsby T67M Fireflies in 2003. Lebanon operated its six Model 126s from Rayack, with three survivors still operational in mid-2018. After receiving its five Bulldog 103s in July 1972, Kenya ordered nine Model 127s which were delivered in the second half of 1976, retiring them by 2013. Two Bulldog 128s entered service with the Royal Hong Kong Auxiliary Air Force in late 1977, remaining in service until sold on the civil market in 1988. A single Bulldog 129 was also built for a civil customer in Venezuela.

One Bulldog 124 was built and used by Scottish Aviation (which became part of British Aerospace in 1977) as a demonstrator. The aircraft participated in light weapons trials for the type, clearing the way for delivery of six Model 1210s to Botswana. Although equipped with under wing hardpoints, the Bulldogs were primarily used as basic trainers, from delivery in June to September 1980, until sold in March 1991. ■

Kenya received 14 Bulldogs in two batches in 1972 and 1976. Leading this line-up from the first batch is 705, which is now preserved as an instructional airframe at the Air Force Academy.

Seen near Bardufoss in Northern Norway, MFI-15 845 serves with the Norwegian Air Force flying school. *Ingeborg Gloppen Johnsen/ Forsvaret*

Saab Safari, Supporter and PAC Mushshak

Prolific and Proficient

Sweden's versatile Saab MFI trainer and light attack aircraft was not adopted by its home air force, but sold well and was built in large numbers in Pakistan.

The MFI can trace its origin as far back as 1958 to the BA-7 designed by Björn Andreasson in the USA. A productionised version was flown by Malmö Flygindustri in Sweden as the MFI-9 Junior in 1962 and built under licence in Germany as the Bölkow Bo 208.

An armed version of the MFI-9 was flown as the Minicom in the Biafran Civil War by mercenary pilots including Swede Count Carl Gustav von Rosen. These were armed with 68mm SNEB rocket pods. In May 1968 the five aircraft attacked Nigerian Air Force bases, destroying several MiG-17 fighters and Il-28 bombers on the ground, preventing them from making more attacks on Biafran civilians. Minicoms also dropped relief supplies in sacks to war-ravaged areas.

The company was purchased by Saab and adapted the design into a two-seat trainer and utility aircraft as the MFI-15 Safari, powered by a Lycoming IO-320-B2 engine rated at 160hp (119kW). The prototype, SE-301, flew on 11 July 1969. Like the MFI-9, the MFI-15 had an unusual configuration for a trainer of a high-mounted wing, which had slight forward sweep. The wing spar passed through the canopy behind the pilot's seat and the crew had an unrestricted view above as well as excellent visibility forward and to the sides. Unusually, a third seat could be fitted with access from the rear.

The Biafran experience encouraged Saab to develop a militarised version as the MFI-17 Supporter. It had a more powerful engine and six hardpoints that could be used to mount light weapons such as gun pods and the Bofors Bantam wire-guided air-to-ground missile, but also to drop supplies,Unlike almost every other Saab product, neither the MFI-15 or -17 were adopted by the Swedish Air Force, but the two types sold well. Sierra Leone was the first military customer, taking two Safaris in 1973 for use as trainers. Zambia acquired 20 MFI-15-200s from 1975. They are now retired. Norway bought the first of 23 to replace their Safirs in 1981 and 15 remain in service today at the *Luftforsvarets Flygeskolen* based at Bardufoss. Denmark bought 32 Supporters as the T-17 in 1975 of which 25 are still in service with the Flyveskolen at Karup. They also form the equipment of the 'Baby Blue' display team. The T-17s are being upgraded with a new digital cockpit and a prototype aircraft was delivered in 2022.

The biggest customer was Pakistan, which bought 28 MFI-17s as the Mushshak (Proficient). A workshop was established at Risalpur to build a further 92 for the Pakistan Army. This became

Saab MFI-17 Supporter

Crew: Two or three
Length: 23ft (7.00m)
Wingspan: 29ft 1in (8.89m)
Height: 8ft 7in (2.60m)
Empty weight: 1,424lb (646kg)
Max T/O weight: 2,646lb (1,200lb)
Powerplant: One Textron Lycoming IO-360-A186 flat-four piston engine rated at rated at 200hp (149kW)
Max speed: 146mph (236km/h)
Service ceiling: 13,450ft (4,100m)
Range: 870 miles (1,400 miles)
Armament: Maximum ordnance 330lb (150kg)

The armed Supporter was extremely agile at low level, making it perfect for low-intensity 'bush wars'. Saab

the Aircraft Manufacturing Factory (AMF), moved to Kamra and was renamed the Pakistan Aeronautical Complex (PAC). An upgraded version with a 210hp (157kW) Continental TIO-360-MB turbo-supercharged engine was first flown as the Shabbaz in 1987, but development did not proceed past two prototypes. Powered by a 260hp (194kW) Lycoming IO-540, the MFI-395 Super Mushshak flew in August 1996 and entered service in May 2001. The instrument panel has two multifunction displays and the air conditioning system is improved. Today there are 119 MFI-395s in the Pakistan Air Force inventory. They serve with two primary flying training squadrons of the Air Academy at Risalpur and with the Station Flights at the various PAF bases.

As many as 214 MFI-17s are operated by the Pakistan Army Air Corps at Lahore, Mangla, Multan, Peshawar, Rawalpindi, Quetta and Rahwali, mostly in composite squadrons alongside helicopters. Iran's Revolutionary Guard Corps obtained 25 Mushshaks in 1991, which they used to establish their first aviation unit. PAC has sold MFI-395s to Oman (seven), Qatar (eight) and Saudi Arabia (20). Syria received six in 1994.

The Super Mushshak is still in production. Azerbaijan's ten were delivered in 2018 and in recent years Iraq has ordered 12; Nigeria, ten; and Turkey, 52. These newer aircraft are equipped with a variety of glass cockpits made by Dynon, Garmin and GenisyS. ■

The Mushshak has served the Pakistan Air Force's Air Academy at Risalpur for more than 30 years.

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Ireland armed its SF.260Ws with rockets for training purposes. They were sold to a broker in the USA in 2007.

SIAI-Marchetti SF.260

Italian Sports Car

The sporty side-by-side aerobatic trainer with wingtip fuel tanks has served with more than 30 air forces in piston-powered and turboprop forms.

The F.250 three-seat tourer/trainer was designed by Stelio Frati for Aviamilano and the prototype, I-RAIE, first flew 15 July 1964 with a 250hp (186kW) Lycoming O-540-AID engine. The design was purchased by SIAI-Marchetti and entered production with a 260hp (194kW) Lycoming O-540-E engine. The civil version sold well to flight schools before the military SF.260M was introduced in 1970. An armed SF.260W Warrior followed in 1972. The aircraft was developed during its life and in July 1980 a turboprop version flew using an Alison 250B-17F engine as the SF.260TP, with the weapons-capable variant being the SF.260TW Turbo Warrior. Several operators have converted piston-engined SF.260s to turbine power. First flown in 2013, the SF-260TD introduced a 'glass' cockpit. The SF.260E was offered, unsuccessfully, for the USAF's Enhanced Flight Screener requirement.

The design rights were transferred to Aermacchi (now Leonardo) in 1997 as the SF-260 and by 2015 a total of 914 had been produced with the makers touting it as the world's most successful primary trainer aircraft. Production appeared to be over, but then a batch of F.260TWs was sold to Zambia for the Flying Training School at Livingstone.

Former operators were Brunei (two), Burkina Faso (19), Burma (21), Burundi (three), Chad (nine captured from Libya), Congo (at least 12), Ethiopia (up to 22), Haiti (six), Indonesia (19), Ireland (11), Italy (51), Mexico (30), Nicaragua (four or six), Singapore (14), Somalia (12), Sri Lanka (18), Thailand (18), Uganda (eight), UAE (seven) and Zimbabwe (37).

Current users include Belgium (27), Italy (29), Mali (one), Mauritania (two), Philippines (18), Türkiye (34), Tunisia, (17), Uruguay (six), Venezuela (11), Libya (37) and Zambia (11).

Belgium's SF.260s have served for more than 50 years, 36 aircraft having been delivered between 1969 and 1971 as replacement for the Stampe SV.4 and a total of 48 seeing service. Over the years they have equipped several aerobatic teams, including the Swallows, Hardship Red and the Red Devils. No fewer than 13 BAF SF.260s have been written off in accidents, while the survivors have been upgraded to SF260M+ standards.

Many SF.260s have moved between operators over the years and the SF.260 has also been successful in the civil market. With its fighter-like performance, it has been operated by several companies for 'dogfight' flying experiences using smoke dischargers to register 'hits'. ■

SIAI-Marchetti SF.260W Warrior

Crew: Two
Length: 23ft 4in (7.10m)
Wingspan: 27ft 5in (8.35m) over tip tanks
Height: 7ft 11in (2.41m)
Empty weight: 1,830lb (830kg)
Max T/O weight: 2,866lb (1,300kg)
Powerplant: One Textron Lycoming O-540-E4A5 flat-six piston engine rated at 260hp (194kW)
Max speed: 190mph (305km/h)
Service ceiling: 14,700ft (4,480km)
Range: 1,066 miles (1,716km)
Armament: Maximum ordnance 661lb (300kg)

The motto of Thailand's Primary Flying School is "First Step of the Air Warriors" and students take that first step in the CT/4E Airtrainer. RTAF

Pacific Aerospace CT/4 Airtrainer

The Plastic Parrot

Designed in Australia, built in New Zealand and sold back to Australia, the Airtrainer has been the basic trainer of three Asia-Pacific air forces and still serves with one of them.

In 1952 Henry Millicer of Australia's Government Aircraft Factories (GAF) designed the Airtourer, which won UK competition for a light aero club aircraft. A group of homebuilders in Melbourne constructed a mostly wooden prototype (VH-FMM), which flew in March 1959.

Millicent took the Airtourer 1 to Victa Industries, a company best known in Australasia for their lawnmowers. The design was updated to be of all-metal construction. It was a conventional low-winged aircraft with side-by-side seating and a large rear-hinged clear canopy. A 100hp (76kW) Continental O-200 engine powered the Australian-built examples.

Victa built 170 Airtourers for the civil market up to 1966 but found they couldn't compete with imported foreign designs and that the government wouldn't provide protection through tariffs. Victa sold the manufacturing and sales rights to Aero Engine Services Ltd (AESL) at Hamilton, New Zealand. AESL completed another 76 AIrtourers, four of which were sold to the RNZAF in 1970 with 150hp (112kW) Lycoming O-320-E1A engines.

A four-seat derivative known as the CT/2 Aircruiser became the basis for development of the CT/4 Airtrainer to compete for the RAAF's trainer aircraft tender, which sought to replace the Winjeel amid the failure of the RAAF's plans for an all-jet training system.

ZK-DGY, the first of two CT/4 (also styled CT-4) prototypes flew in February 1972. Compared to the Aircruiser it was strengthened for aerobatics and had a revised two-seat cockpit with a jettisonable canopy. Power came from a 210hp (112kW) Continental IO-360H engine

Australia ordered 37 as the CT/4A in July 1972 and Thailand also purchased the type, ordering 24 in September. To cope with these large orders, AESL formed a new company with Air Parts (NZ) Ltd, Air New Zealand and the New Zealand National Airways Corporation (NAC). This became NZ Aerospace Industries in 1973.

The RTAF aircraft were the first to be completed and all delivered by the end of 1974 to 1 Flight Training Squadron at Nakhon Pathom, also known as the Basic Training Squadron.

The RNZAF purchased 14 CT/4Bs to replace the Harvard in 1976-77. Their instrument panel layout was modelled on that of the BAC.167 Strikemaster, which was used for advanced training. These were issued to the Flight Training Wing at Wigram, and flown by the Pilot Training Squadron and the Central Flying School. The Airtrainer also equipped the 'Red Checkers' aerobatic team from 1980 until 2014. The team used between four and seven aircraft.

In RAAF service the Airtrainer served with No. 1FTS at Point Cook and the CFS at East Sale. Student pilots called it the 'Plastic Parrot' or 'Plastic Rat'. It's orange-and-white livery was known as the 'Fanta Bottle' scheme.

Production of the CT/4A and B reached 114 examples. Of these, 14 CT/4Bs were built for a Swiss company that was acting as a front for Rhodesia. Although paid for, they were not delivered when this sanctions-busting scheme was discovered and remained in storage until the RAAF bought them in 1980 and had them

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Red Checkers

RNZAF CT/4Es in the later yellow colourscheme. The aircraft wear the cowling that marked the 'Red Checkers' aerobatic team's aircraft. *Jim Winchester*

converted to CT/4A standard, bringing their total up to 51.

NZAI became Pacific Aerospace Corporation (PAC) in 1982. An RNZAF aircraft was modified with an Allison 250 turboprop in 1991 as the CT/4C to compete for the USAF's flight screening requirement and converted back to piston power the following year. Designed for a 14,000hr fatigue life and a structural rating of +6 and -3g with a 300hp (224kW) AEIO-540 engine, the CT/4E also flew in 1991 and was eventually successful, with 12 going to the RNZAF in 1998-99, replacing CT/4Bs, by now at Ohakea, and Thailand ordering 24. The RTAF aircraft replaced the CT/4As with 1 FTS, but some As were transferred to No. 604 Squadron at Don Mueang.

The RAAF retired the Airtrainer in 1992, having contracted out basic training to private industry, which bought more Airtrainers. The Australian Defence Force Basic Flying Training School at Tamworth, NSW was operated by BAE Systems flew 12 new-build CT/4As among other types, until the contract ended in 2019 and the ADF brought its basic training back in house.

The CT/4F with a Raytheon glass cockpit flew in 2006, but attracted no orders.

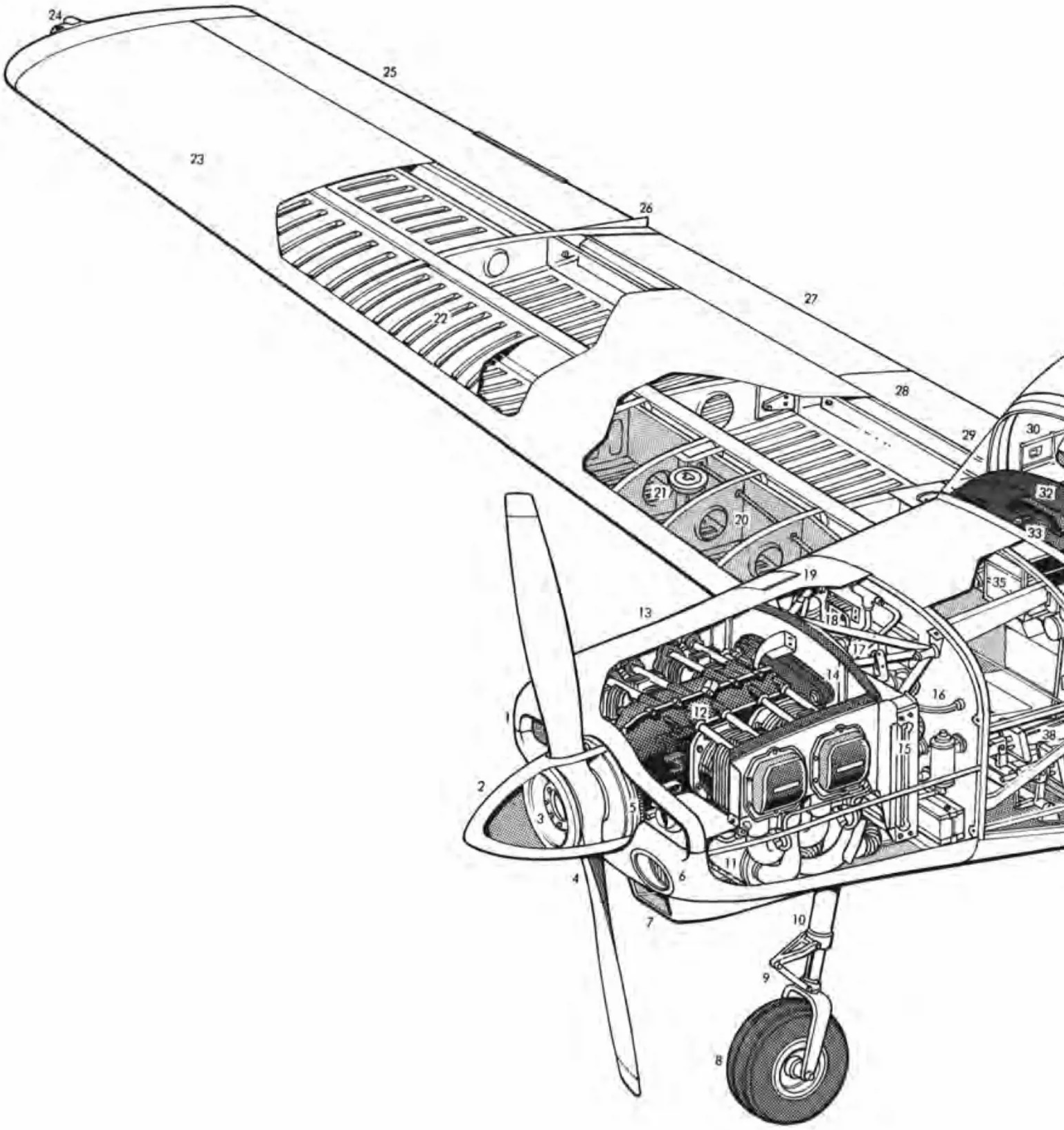
Singapore's Youth Flying Club was the final new customer for the CT/4E, buying two in 2001. The Airtrainer is still being marketed by NZ Aero, the successor to PAC, with the latest version being the CT/4G with a Garmin 1000 glass cockpit. ■

A CT/4A Airtrainer from the Australian Defence Force Basic Flying Training School conducting another training sortie in the airspace around Tamworth, New South Wales. *Cpl Craig Barrett*

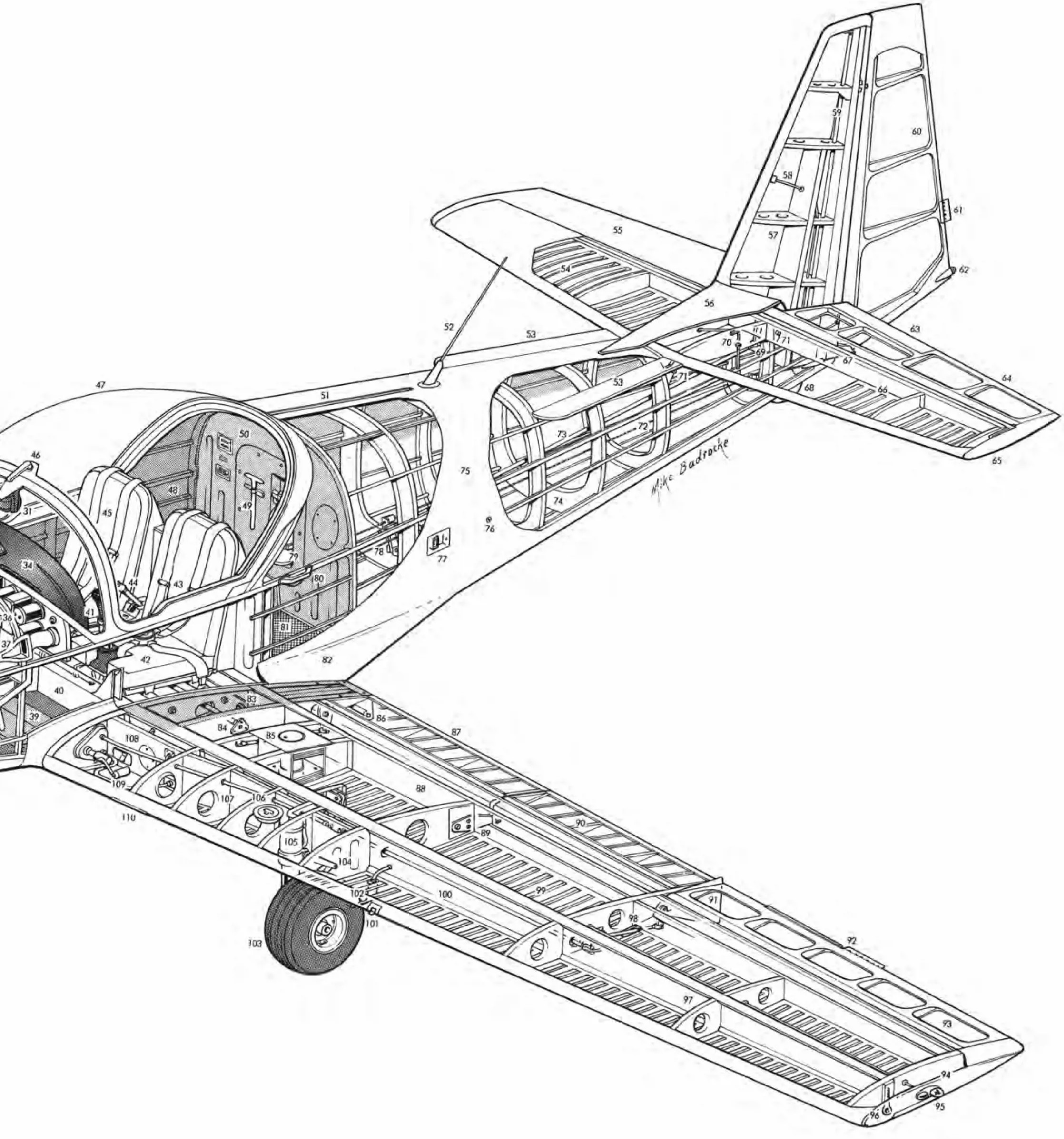
PAC CT/4A Airtrainer

Crew: Two
Length: 23ft 2in (7.06m)
Wingspan: 26ft 0n (7.92m)
Height: 8ft 6in (2.59m)
Empty weight: 1,460lb (675kg)
Max T/O weight: 2,400lb (1,089kg)
Powerplant: One Rolls-Royce (Continental) IO-360-H flat-six air-cooled piston engine rated at 210hp (157kW)
Max speed: 163mph (262km/h)
Service ceiling: 17,900ft (5,455m)
Range: 815 miles (1,311km)
Armament: None

Slingsby T-67C Firefly Cutaway



1 Cooling air intake
2 Spinner
3 Propeller hub attachment bolts
4 Two-bladed fixed-pitch propeller
5 Engine starter ring
6 Landing/taxying light, port and starboard
7 Carburettor air intake
8 Fixed nosewheel
9 Torque scissor links
10 Nosewheel leg strut
11 Exhaust silencer
12 Textron Lycoming AE10-320-D1B flat-four engine
13 Two-piece glass-fibre reinforced plastic (GFRP) engine cowlings
14 Engine bay air baffles
15 Engine mounting sub frame
16 Stainless steel firewall
17 Accessory equipment compartment
18 Engine bearer struts
19 Oil filler access panel
20 Starboard wing integral fuel tank, total fuel capacity 35 Imp gallons (159 litres)
21 Fuel filler cap
22 Corrugated GFRP inner skin doubler
23 GFRP inner skin doubler
24 Starboard navigation (green) and strobe (white) lights
25 Starboard aileron
26 Aileron endplate
27 Starboard plain flap
28 Flap Kevlar skin panel
29 Single curvature windscreen panel
30 Direct vision panel, port and starboard
31 Stand-by compass
32 Grab handle
33 Glideslope aerial
34 Instrument panel shroud
35 Radio equipment rack
36 Back of instrument panel
37 Fresh air intake
38 Rudder pedals with toe brakes
39 Footwell
40 Wing spar, continuous through fuselage
41 Control column, full dual control
42 Student pilot's seat
43 Safety harness
44 Handbrake lever
45 Instructor's seat (seat layout reversed in USAF EFS variant)
46 Canopy latch
47 Aft-hinged acrylic cockpit canopy
48 Baggage compartment
49 Emergency canopy breaker
50 Cockpit bulkhead
51 Rear canopy rail
52 ELT aerial
53 Spin strakes
54 Tailplane corrugated GFRP inner skin doubler
55 Starboard elevator
56 Fin root fillet
57 GFRP rudder construction
58 Internal VHF aerial
59 Lightning conductor
60 GFRP rudder construction
61 Fixed rudder tab
62 Tail navigation light
63 Elevator trim tab, Bowden cable operated
64 GFRP elevator construction
65 Elevator horn balance
66 All-GFRP tailplane construction
67 Rudder hinge control
68 Tail bumper
69 Elevator control rod
70 Internal VOR aerial
71 Tailplane attachment bolted joints
72 Rudder control cables
73 Elevator control rod
74 GFRP fuselage frames and stringers
75 Bonded GFRP skin panelling
76 Static port
77 Ground power socket (optional)
78 Control rod hinge link
79 Fire extinguisher bottle
80 Grab handle
81 Baggage floor
82 Wing root fillet
83 Wing walkway
84 Flap operation linkage
85 Main undercarriage leg
86 Ventral boarding step
87 Port plain flap
88 GFRP rear spar
89 Central flap hinge
90 GFRP flap construction
91 Aileron endplate
92 Fixed aileron tab
93 GFRP aileron construction
94 Wing tip fairing
95 Port navigation light (red) and strobe (white) lights
96 Wing tip tie-down point
97 GFRP main spar and ribs
98 Aileron hinge control linkage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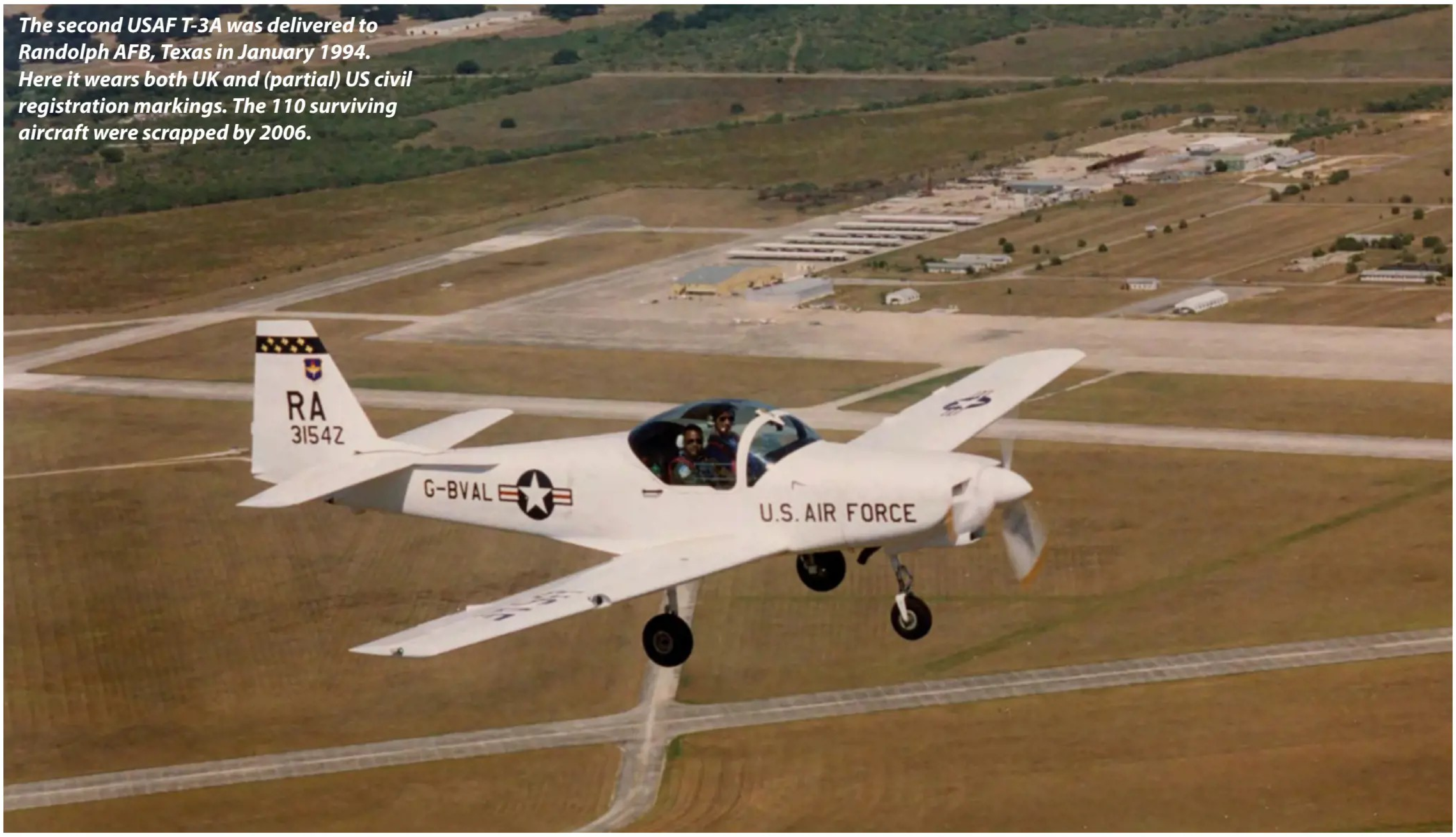
Mike Badrocke

99 Lower wing skin panel and doubler
100 Aileron push-pull rod
101 Stall warning
102 Ventral pitot head
103 Port mainwheel
104 Torque scissor links
105 Fixed mainwheel leg strut
106 Fuel filler cap
107 Port wing integral fuel tank
108 Collector tank
109 Fuel contents unit
110 Leading-edge stall strip


The second USAF T-3A was delivered to Randolph AFB, Texas in January 1994. Here it wears both UK and (partial) US civil registration markings. The 110 surviving aircraft were scrapped by 2006.

Slingsby T67 Firefly

Upset Trainer

Beginning as a French motor glider, the Firefly was one of the first military training aircraft to be supplied mainly through contractor-owned, contractor-operated (Co-Co) schemes. Its reputation was somewhat tarnished by accidents in USAF service.

Slingsby was mainly known for its primary training gliders such as the T3 and the T21. It acquired the rights to the Fournier RF-6B motorised glider from its French owners in 1981. The British company, based at Kirkbymoorside in Yorkshire, built ten as the T67A before revising the design to replace the largely wooden construction with composites. The T67B flew in 1982 and was predominantly made from glass reinforced plastic (GRP). It had a fixed undercarriage and side-by-side seating under a bubble canopy. Showing its glider origins, the most notable feature was its long wingspan compared to the fuselage length.

The design was adapted to military use as the T67M with a 160hp (119kW) AEIO-320-D1B engine. There were 20 built before production switched to the T67M200 with the 200hp (149kW) AEIO-360-A1E. In 1992 the similar T67C3 became the primary training aircraft for the Canadian Forces, with 12 aircraft based at Portage la Prairie, Manitoba, owned by Canadair/Bombardier and flown by civilian instructors. When the contract ended in 2006, the 'Slingsby' as it was commonly known, was replaced by the Grob 120

With structural limits of +6 to -3g, the T67 was particularly suitable for aerobatic instruction, including Upset Prevention and Recovery Training (UPRT) to teach pilots how to anticipate, avoid and recover upsets during flight. It had a cruise speed of 150mph (240km/h) and an endurance of more than five hours.

Other military operators included Bahrain (three), Jordan (14), Hong Kong (four) and civilian schools in the Netherlands, Turkey and Norway that supplied pilots for those nations' air arms.

In the UK, Hunting Aviation won a contract to supply flight screening using 22 civilian-registered T67M Mk. IIs. These served at the Joint Elementary Flying Training School (JEFTS) at RAF Topcliffe and Barkston Heath from 1995 until 2010.

The biggest order came in April 1992 for 113 T67M260s for the USAF's Undergraduate Pilot Training (UPT) scheme. This version had a 260hp (195kW) AETO-540-D4A5 engine and other modifications. As the T-3A Firefly, it entered service at the AIr Force Academy in Colorado Springs and at Hondo, Texas from October 1994.

Unfortunately with the bigger powerplant and a tighter cowling, the T-3A suffered numerous incidents of vapour lock and engine stoppages. The Firefly's brakes proved inadequate for the long taxying distances around the huge US airfields. There were three fatal accidents in USAF service and the engine issues were never entirely solved. In 1997 Air Education and Training Command grounded the Fireflies and ordered them scrapped in 1999. None were saved, not even for the USAF Museum, which tries to preserve every retired type. ■

Slingsby T-67M Firefly

Crew: Two
Length: 24ft 0in (7.32m)
Wingspan: 34ft 9in (10.59m)
Height: 7ft 9in (2.36m)
Empty weight: 1,450lb (658kg)
Max T/O weight: 2,100lb (952kg)
Powerplant: One Textron Lycoming AEIO 320-D2A flat-four piston engine rated at 160hp (119kW)
Max speed: 153mph (246km/h)
Service ceiling: 12,000 ft (3,660 m)
Range: 650 miles (1,046km)
Armament: None

A civilian-owned Vinka landing at the Royal International Air Tattoo in 2024.

Jim Winchester

Valmet Vinka and Redigo

Northern Wind

One of the more obscure military trainers, the Vinka served only with Finland, while its successor the Redigo had an odd mix of operators, including a US contractor.

The Vinka was conceived in the early 1970s to replace the Saab Safir as the primary trainer for the Finnish Air Force (Ilmavoimat). Designed and manufactured by a branch of state industrial conglomerate Valmet Oy, the prototype Leko-70 (L-70) made its first flight on 1 July 1975, piloted by Paavo Janhunan.

The Vinka (Wind Blast) was not unlike the Bulldog, with a fixed undercarriage and side-by-side seating under a large canopy. There was space for two passengers at the rear or a stretcher patient and attendant. With a 200hp (149kW) Lycoming engine and the fixed gear, the performance was not high, but the type was rugged and said to have a fatigue life of 8,000hr in heavy military use. There were four hardpoints under the wing for a maximum of 660lb (300kg) of external stores, although these seem to have been rarely carried.

A batch of 30 was built for the Ilmavoimat and two more retained by the manufacturer for trials. Delivered in 1980-82, the Vinkas were based mainly with the Air Academy at Kauhava, but when flying training was contractorised in 2005, the fleet was relocated to Tikkakoski where it was maintained by defence industry group Patria. Vinkas were also attached to the fighter squadrons as liaison aircraft.

Valmet marketed the type as the L.70 Militrainer but failed to achieve any overseas sales. The Vinka was retired at the end of August 2022 and the Ilmavoimat now uses the Grob G115E, also maintained by Patria.

When the Magister was retired, it was felt that the jump from the Vinka to the new BAe Hawk was too great. An L-70 was fitted with a 360shp (269kW) Alison 250-B17D turboprop to become the L-80TP. Its life was short, flying on 12 February 1985 but being lost in a crash while spin testing on 24 April. A second prototype had a Turboméca TP319 engine. The tail design was revised to improve spinning characteristics and the L-90TP Redigo flew on 1 July 1986 Compared to the Vinka it had a new wing with six hardpoints and a retractable undercarriage. Finland bought ten but used them mainly as liaison aircraft.

The Mexican Navy operated nine L-90TPs from 1993, but they are now retired, as are the eight supplied to the Eritrean Air Force in 1994. Italy's Aermacchi later bought the license to produce the Redigo, rebranding it as the M-290, but never produced any more.

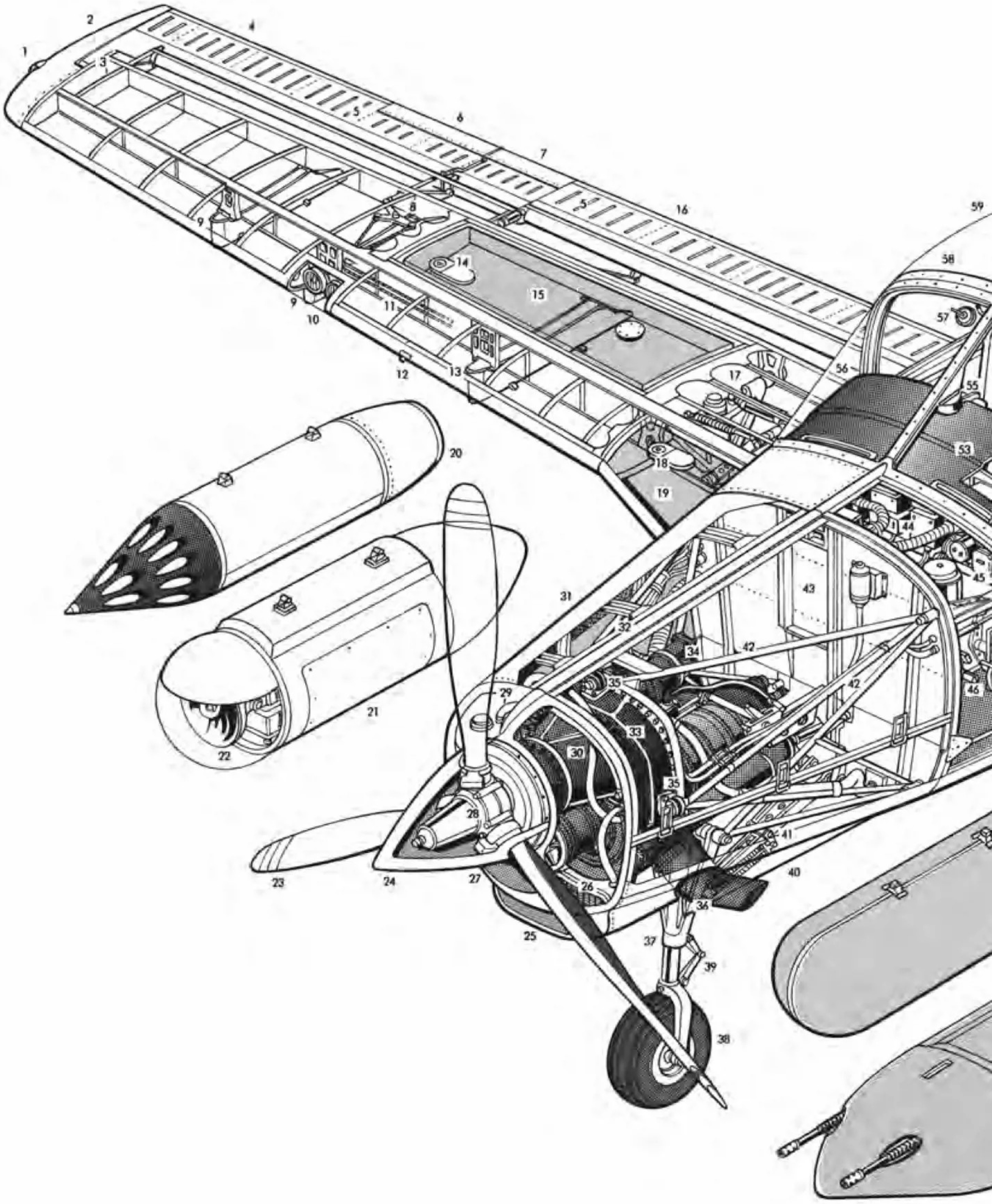
In 2017 private contractor Blue Air Training in the US bought the available Finnish aircraft and the remaining spares inventory and operates a fleet of four which are used to train JTACs. They have been modernised as the A-90 Raider and can carry weapons. ■

Valmet L-70 Vinka

Crew: Two or four
Length: 24ft 7in (7.50m)
Wingspan: 31ft 7in (9.63m)
Height: 10ft 10in (3.31m)
Empty weight: 1,691lb (767kg)
Max T/O weight: 2,756lb (1,250kg)
Powerplant: One Textron Lycoming AEIO-360-A1B6) flat-four piston engine rated at 200hp (149kW)
Max speed: 146mph (235km/h)
Service ceiling: 16,405ft (5,000m)
Range: 590 miles (950km)
Armament: Up to 600lb (300kg) of external stores such as gun pods, rocket pods or light bombs

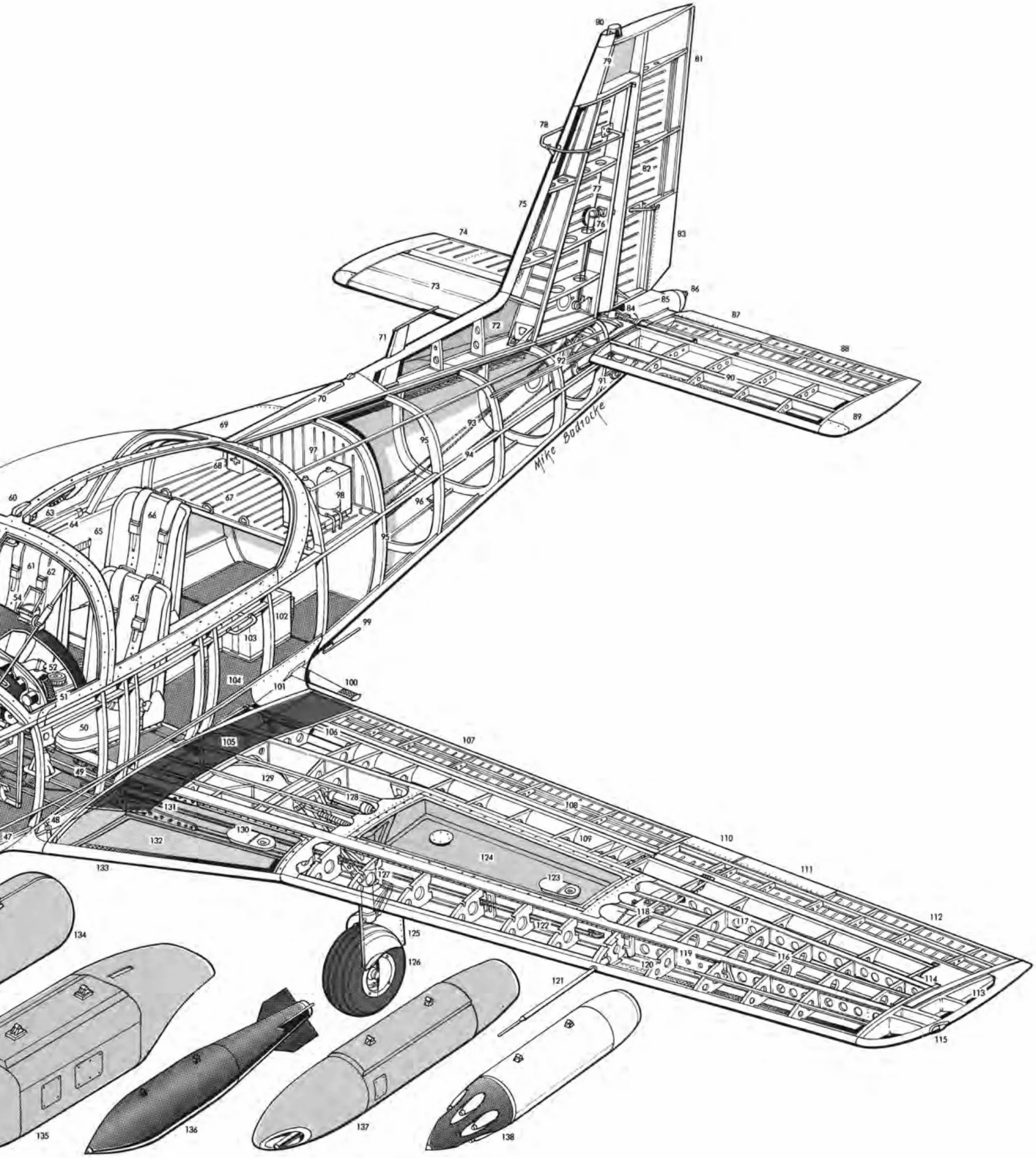
Valmet L-80TP Redigo

1 Starboard navigation light
2 wing tip fairing
3 Aileron mass balance
4 Starboard Frise-type aileron
5 Integrally stiffened control surface skin panels
6 Aileron spring tab
7 Balance tab
8 Aileron hinge mechanism
9 Outboard stores pylons (330lb/150kg capacity each)
10 Landing/taxying lamps
11 Aileron control cables
12 Stall warning vane
13 Inboard stores pylon (551lb/250kg capacity)
14 Fuel filler cap
15 Starboard outer main fuel tank, total system capacity 77 Imp gal (350 litres)
16 Single-slotted Fowler-type flap
17 Starboard main undercarriage leg pivot fairing
18 Fuel filler cap
19 Starboard leading-edge fuel tank
20 CASA 18-037 rocket launcher (18x37mm rockets)
21 Searchlight pod
22 Steerable searchlight unit
23 Three-bladed Hartzell constant-speed propeller
24 Propeller spinner
25 Oil cooler air intake
26 Oil radiator
27 Engine air intake
28 Propeller hub pitch change mechanism
29 Engine oil tank (2 Imp gal/9 litre capacity)
30 Propeller reduction gearbox
31 Detachable engine cowling panels
32 Cowling top hinges
33 Allison 250-B17D turboshaft engine
34 Engine accessory equipment
35 Main engine mountings
36 Exhaust duct, port and starboard
37 Nose undercarriage leg strut
38 Steerable nose wheel, aft retracting
39 Torque scissor links
40 Nosewheel leg doors
41 Retraction mechanism
42 Engine bearer struts
43 Fireproof bulkhead
44 radio racks
45 Instrument panel
46 Rudder pedals
47 Cockpit floor level
48 Wing leading-edge attachment link
49 Wing spar centre-section
50 Pilot's seat
51 Control column
52 Centre console
53 Instrument panel shroud
54 Reflex sight, detachable (tactical support and weapons training roles)
55 Stand-by compass
56 Windscreen panels
57 Temperature probe
58 Canopy arch frame
59 Sliding cockpit canopy cover
60 Canopy latch
61 Second pilot's seat
62 Five-point safety harness
63 Canopy emergency release handle
64 Sliding canopy side rail
65 Cabin wall trim panelling
66 Removable rear seat, port, starboard on both sides
67 Light baggage shelf
68 First-aid kit
69 Fuselage skin panelling
70 Sliding canopy top rail
71 Upper VHF aerial
72 Fin root fillet
73 Starboard tailplane
74 Starboard elevator
75 Fin leading edge
76 Tim tab screw jack
77 Tailfin construction
78 VOR/ILS aerial
79 Rudder horn balance
80 Anti-collision light
81 Rudder
82 Integrally stiffened skin panels
83 Rudder trim tab
84 Rudder and elevator hinge controls



85 Tailcone
86 Tail navigation light
87 Elevator tab
88 Port elevator construction
89 Elevator horn balance
90 Taillplane construction
91 Ventral tail bumper/tie-down point
92 Elevator control linkage
93 Tailplane control cables
94 Fuselage main longeron

95 Rear fuselage frames
96 Ventral DME aerial
97 Cabin rear bulkhead
98 Optional crew oxygen equipment
99 Lower VH aerial
100 Boarding step
101 Wing-root fillet
102 Battery
103 Handgrip
104 Cabin floor panelling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105 Wing walkway
106 Flap control torque shaft
107 Port Fowler-type flap
108 Flap rib construction
109 Flap shroud ribs
110 Balance tab
111 Aileron spring tab
112 Port aileron rib construction
113 Glassfibre wing tip fairing
114 Aileron mass balance
115 Port navigation light
116 Outer wing panel rib construction
117 Rear spar
118 Aileron control linkage
119 Front spar
120 Leading-edge nose ribs
121 Pitot tube
122 Aileron cables
123 Fuel filler cap
124 Port outer main fuel tank
125 Mainwheel leg door
126 Port mainwheel
127 Main undercarriage leg strut
128 Hydraulic retraction jack
129 Main undercarriage leg strut
130 Hydraulic retraction jack
131 Main spar attachment bolted joints
132 Port leading-edge fuel tank
133 Extended-chord inboard leading-edge section

Two of India's first PC-7 Mk IIs before delivery. They operate with training squadrons at Dundigal and Tambaram. Aldo Wicki/Pilatus

Pilatus PC-7

Swiss Evergreen

Built to replace the underpowered P-3, the PC-7 has been used as the primary trainer by more than 20 nations. It was the first of the modern generation of turboprop trainers and is still in production after nearly 50 years.

P-3 HB-HON was refitted with a PT6A-20 engine and flew on 12 April 1966. It also had provision for wingtip tanks. Unfortunately for Pilatus, the Schweizer Luftwaffe intended to retain its piston-engined P-2 and P-3 trainers into the 1980s, and export prospects at the time looked poor. When HB-HON suffered a wheels-up landing in September 1970, development was shelved. Increasing fuel prices and the need for more cost-effective training saw the project revived and a second aircraft (HB-HOZ) was converted to turbine power, this time with a more efficient PT6A-25 engine, and flown on 12 May 1975.

The test programme of what was now the PC-7 Turbo Trainer saw the enlargement of the tail surfaces and addition of a strake under the

The PC-7 can be equipped with light weapons for ground attack. Here an Austrian example fires rockets on a Slovenian training range during a 2015 exercise. Austrian Air Force/Markus Sinner

Switzerland's PC-7 Team, seen performing at the 2018 Royal International Air Tattoo, flies the first-generation aircraft with the level cockpits and no ejection seats. *Jim Winchester*

A-934
A-918
A-938
A-924
A-916
A-931
A-925

rear fuselage, although it was much smaller than that on the P-3-03.

By the time the first production PC-7 flew on 18 August 1978, dihedral had been added to the outer wing panels and the side-opening canopy had lost most of its framing. The -25 engine allowed for inverted flight and general airframe strengthening raised the g limits to +4.54 and -2.25. Fatigue life was set at 18,000hrs with an average utilisation of 600-800hrs annually.

The cockpit is unpressurised and in the baseline (Mk I) PC-7, there are no ejection seats, with both seats on the same level.

In contrast with the first iteration of the Turbo Trainer, sales interest was high, with the first orders coming from Bolivia for eight and Burma for 12. The Swiss Air Force finally paid attention and evaluated the PC-7. Although having planned to keep the P-3, Vampire and Venom training syllabus into the mid-1980s, the PC-7 showed that training from ab initio to advanced level could be done much more economically with a turboprop, although it was not then considered suitable for tactical training.

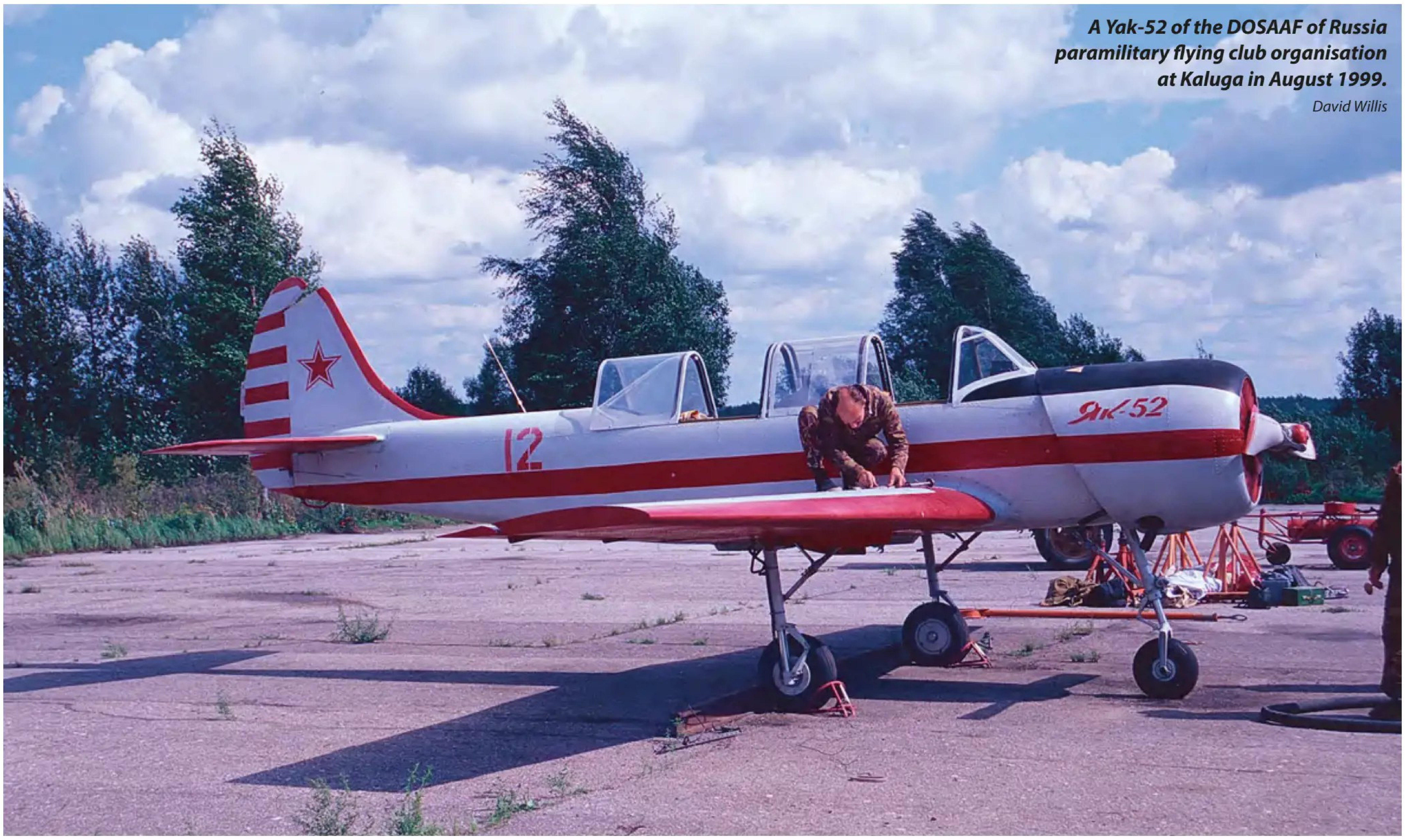
An order for 40 from the Swiss Air Force came in May 1981, with the type into introduced into Schweizer Luftwaffe service in 1982. A PC-7 team with nine aircraft first displayed in 1987 and in 1989 it received its official name: the PC-7 Team. Since then it has flown aerobatic displays all over Europe. Today the Swiss PC-7s equip the Pilotenschule at Locarno and Instrumentenflugstaffel 14 at Emmen. They were upgraded with modern cockpit instrumentation by 2007.

The PC-7 has constantly been updated since the original mid-1960s design initially with the PC-7 Mk II, which was launched in 1992 to bid for a South African Air Force requirement. HB-HMR made the variant's first flight on 28 September 1992 and production started in January 1994. The Mk II has a reduced-drag airframe based on that of the PC-9M and a higher-powered PT6A-25C engine with a four-bladed propeller. Martin-Baker Mk 11A ejection seats are standard and the rear seat is stepped up, giving a better view for the instructor. From 1996 PC-7s Mk IIs and PC-9s were built from common fuselages, PC-7 operators include Angola (26); Austria (16); Bolivia (24); Bophuthatswana (three); Botswana (eight, plus five Mk IIs); Brunei (four); Chad (two); Chile (ten); France (five); Guatemala (12); India (75 Mk IIs); Iran (35); Iraq (52); Malaysia (44 plus 19 Mk IIs); Mexico (88); Myanmar (19); Netherlands (13); South Africa (60 Mk IIs); Suriname (three); Switzerland (40); UAE (31); Uruguay (seven). Military aerobatic display teams with PC-7s have included Brunei's 'Alap-Alap Formation', South Africa's 'Silver Falcons' and Malaysia's 'Taming Sari'. The civilian Martini display team also operated four from 1987.

In 2021 Pilatus launched the PC-7 MKX Basic Trainer. Its main improvements over the Mk II are a new cockpit based on the Garmin G3000 PRIME avionics suite. featuring a large primary flight display and multi-function displays to give students the earliest possible exposure to the technology found in today's front line aircraft. In March 2025 the French Air Force announced an order for 22 aircraft to provide basic training from 2027 and in November the Belgian Air Force approved purchase of 18 along with a 20-year support package. ■

Pilatus PC-7 Mk II

Crew: Two
Length: 33ft 3in (10.13m)
Wingspan: 33ft 5in (10.18m)
Height: 10ft 8in (3.26m)
Empty weight: 3,802lb (1,725kg)
Empty weight: 3,681lb (1,670kg)
Max T/O weight: 6,283lb (2,850kg)
Powerplant: One Pratt & Whitney Canada PT6A-25C turboprop flat rated at 700shp (522kW)
Max speed: 345mph (556km/h)
Service ceiling: 25,000ft (7,620m)
Range: 932 miles (1,500km)
Armament: 0.50in gun pods, rockets or bombs



A Yak-52 of the DOSAAF of Russia paramilitary flying club organisation at Kaluga in August 1999.

David Willis

Yakovlev Yak-52

The Yak is Back

Designed as a successor to the Yak-18, the Yak-52 owed a lot to the Nanchang CJ-6, which was a much-refined development of the original Soviet design, that itself could in turn trace its origins back to the 1930s.

The single-seat Yak-50 flew first, in 1973, and was very similar in appearance to the Yak-18PS, although with many detail differences. It has a tailwheel undercarriage and is mostly used for competition aerobatics. A two-seat Yak-52, at first called the Yak-50U, flew in 1976 with production assigned to IAv at Bacău in Romania.

The main visual difference from the CJ-6 was the lack of dihedral on the inner wing panels

The wheels all remain partly exposed when retracted, providing a measure of protection in the case of a belly landing. The Yak-52 is capable of inverted flight for up to two minutes continuously and the airframe is stressed to +7 and –5 g. Like the Yak-50 it can be used for competition aerobatics and has been operated by a number of military and civil teams.

After the Cold War, IAv was renamed Aerostar and continued to produce the Yak-52, (rendered as Iak-52), with around 1,900 completed. Aerostar developed an improved version as the Condor with a new tail unit and a Lycoming AEIO-540-L1B5D engine of 300hp (224kW). It remained a single prototype. There is also the Yak-52TW, which offers a tailwheel configuration and the similar Yak-52TD, available as a conversion by Termikas in Lithuania.

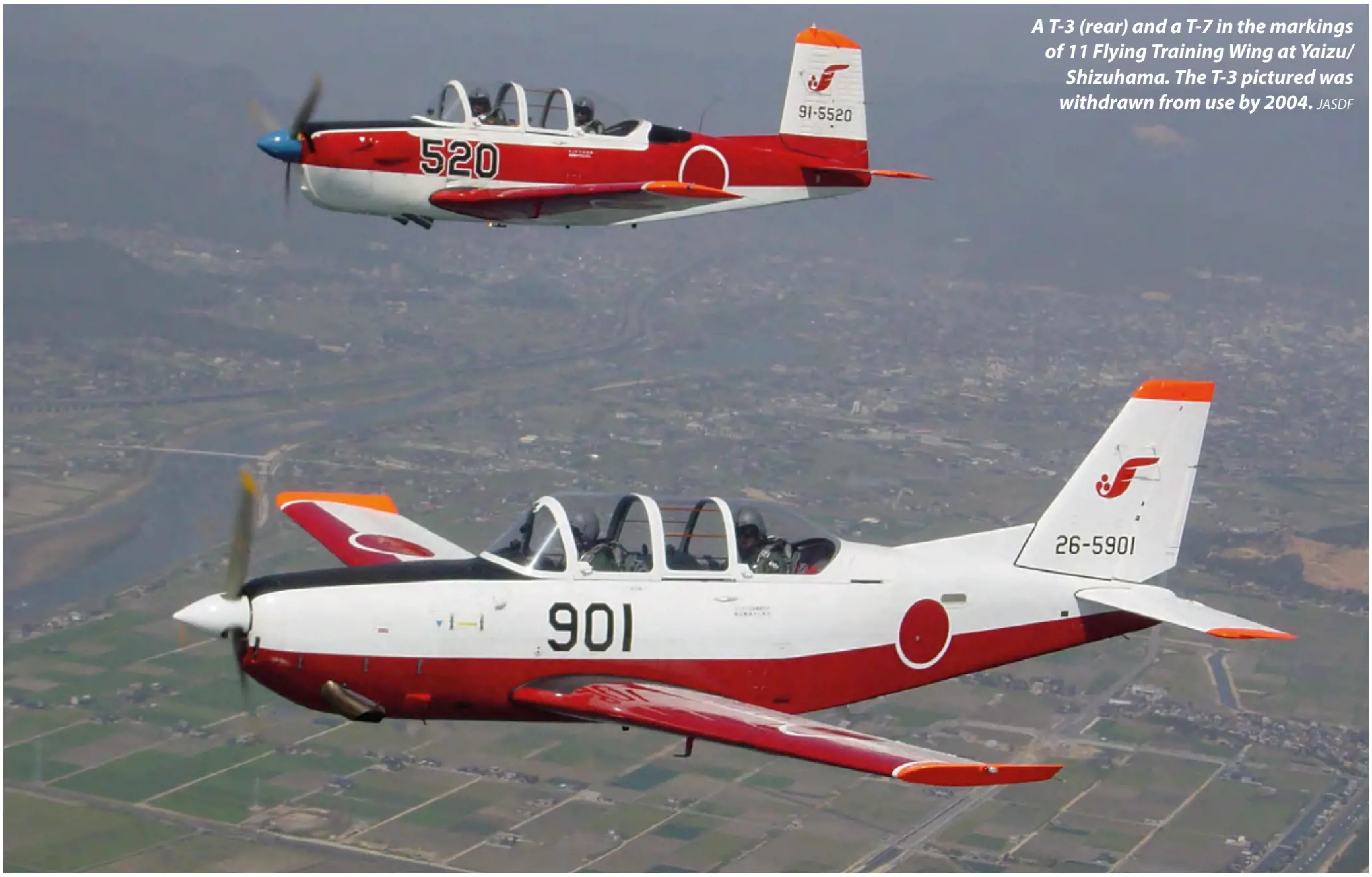
The Yak-52 still serves with the paramilitary DOSAAF of Russia organisation. About a dozen are remain in use with the Romanian Air Force, but most airworthy aircraft are in civilian hands.

While a few Yak-52PS prototypes with four underwing stores pylons were built, the series remained mostly unarmed. In the Russia-Ukraine War, however, Ukrainian Yak-52s have been used as anti-drone fighters. Initially operated by the country's Civil Air Patrol, they have since been incorporated into Army Aviation. With a gunner in the rear seat operating an assault rifle, the Yak-52 has proved effective against Shahed/Geran-type attack drones and Orlan and ZALA surveillance drones, which fly at about 115mph (186km/h), well above the Yak's stalling speed.

Facing its own drone problem, Russia claims to have developed the Yak-52B2 variant which incorporates a EO/IR sensor ball and an underwing machine-gun. If that doesn't work, the backseater is armed with a shotgun. ■

Yakovlev Yak-52

Crew: Two
Length: 25ft 5in (7.75m)
Wingspan: 30ft 6in (9.30m)
Height: 8ft 10in (2.70m)
Empty weight: 2,238lb (1,015kg)
Max T/O weight: 2,877lb (1,305kg)
Powerplant: One Vedeneyev M-14P radial piston engine rated at 360hp (268kW)
Max speed: 177mph (285km/h)
Service ceiling: 13,125ft (4,000m)
Range: 310 miles (500km)
Armament: Hand-held machine-gun in rear seat



A T-3 (rear) and a T-7 in the markings of 11 Flying Training Wing at Yaizu/ Shizuhama. The T-3 pictured was withdrawn from use by 2004. JASDF

Fuji T-3 and T-7

Japanese Beech

Japan took the 1940s-era T-34 Mentor and modernised it for service in the 1980s then did it again in the 2000s.

The first Japanese derivative of the T-34A was the LM-1 Nikko liaison aircraft, flown in June 1955 with a four-seat cabin. There were 27 built for the JGSDF, some of which were converted to LM-2s with a 340hp (254kW) Lycoming IGSO-480 engine. Fuji Heavy Industries then produced the KM-1 two-seat civil trainer and from it the KM-2, which also had a supercharged 340hp engine, three-bladed propeller and provision for light weapons. First flown on 26 September 1974, the KM-2B retained the wide fuselage but re-adopted tandem seating and was selected in August 1975 as the JASDF's new primary trainer.

Renamed T-3 the KM-2B was introduced in 1978, and a total of 50 were produced by 1982 as replacements for the T-34.

Along the lines of the T-34C, a turbine-engined successor was developed, initially as the T-3 Kai (Improved).

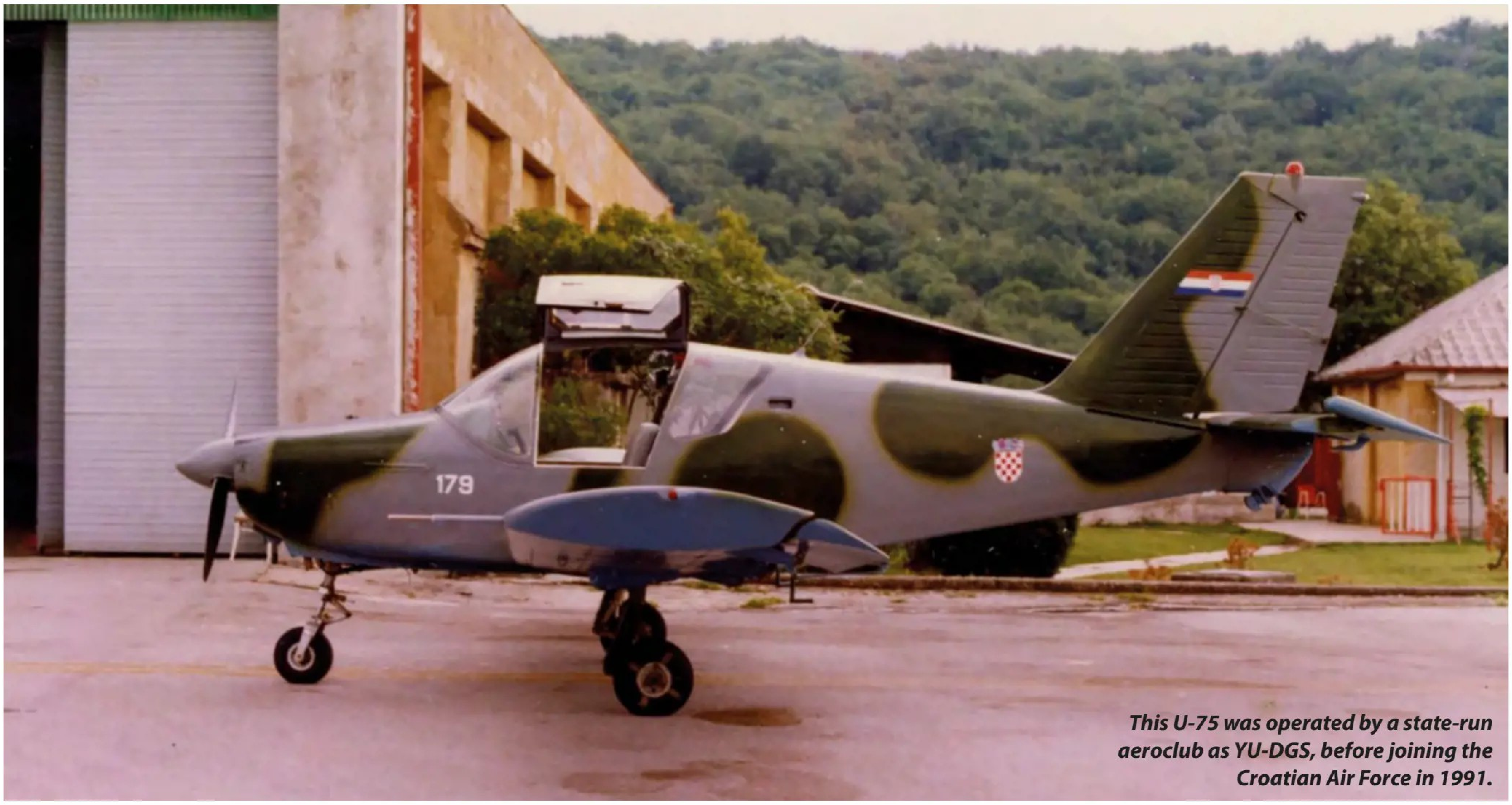
The T-3 Kai was preferred over the Pilatus PC-7 and selected in September 1998, but the contract was cancelled following allegations of corruption. A new competition was opened and the Fuji offering was chosen again as the T-7 in 2000. This had a Rolls-Royce 250-B17F turboprop rather than the Turbo Mentor's PT6 and featured a single exhaust, low down on the starboard side of the nose. The most distinctive feature of the T-7 is its its swept tail fin compared to the that on the T-34 and T-7.

The T-7 took its maiden flight in July 2002. As usual, the Japanese Defense Agency (JDA) purchased its aircraft in small batches, receiving 11 T-7s in 2003, ten in 2004 and 20 in 2005-2006. Production finished with delivery of the 49th and last aircraft in September 2008. The T-3s were retired in 2007 and T-7s serve with 11 Flying Training Wing at Yaizu, 12 FTW at Hofu and Air Development and Test Command at Gifu.

In August 2024 the JASDF took the first steps towards selecting a replacement, issuing a requirement which was met by four contenders, including the Pilatus PC-7MKX and the Beech/Textron T-6 II. The latter was announced as the winner in January 2025 and 36 aircraft plus advanced simulators will be delivered from 2029-32. ■

Fuji T-7

Crew: Two
Length: 28ft 2in (8.59m)
Wingspan: 32ft 11in (10.04m)
Height: 9ft 9in (2.96m)
Empty weight: 2,385lb (1,082km)
Max T/O weight: 3,979 lb (1,805 kg)
Powerplant: One Rolls-Royce 250-B17F turboprop engine rated at 451hp (336kW)
Max speed: 234 miles (376km/h)
Service ceiling: 25,000ft (7,620m)
Range: n/a
Armament: None



This U-75 was operated by a state-run aeroclub as YU-DGS, before joining the Croatian Air Force in 1991.

UTVA-75

Versatile Balkan Trainer

The innocuous civilian appearance of the UTVA-75 belies its armed roles, not just as a weapons trainer, but as a light combat aircraft that saw action in the wars in the former Yugoslavia.

UTVA at Pančevo, Yugoslavia was best known for the tandem-seat Aero 3 of 1956 that became the primary trainer of the Jugoslovensko Ratno Vazduhoplovstvo (JRV) or Yugoslav Air Force. By the early 1970s the mostly wood-and-fabric Aero 3 was becoming obsolete. A more modern all-metal aircraft with side-by-side seats was drawn up and the prototype of the UTVA-75 (for 1975) flew on 19 May 1976.

Slightly resembling a chunkier Piper Cherokee, the production Production UTVA-75A21 (or U-75) was powered by a Lycoming engine driving a two-bladed constant-speed propeller. This gave enough power for basic aerobatics. Its wide-track tricycle landing gear with a steerable nose wheel made it suitable for operations from unprepared strips. It was equipped with a hook for towing gliders or air targets, and was capable of carrying droppable cargo pods from underwing pylons. These hardpoints could also be used for weapons such as bombs up to 100kg or gunpods aimed by a simple gunsight on the left side of the cockpit. U-75s were also seen with twin 128mm rocket launchers or single 57mm pods on each pylon.

Also known as the V-53, from 1978 most of the aircraft were issued to local (civil) aero clubs as part of a national pilot training scheme, while remaining property of the defence ministry. The clubs trained reserve pilots who could serve in the regular forces in wartime.

When Yugoslavia broke up, U-75s wound up in the service of Croatia, Montenegro, Serbia, Slovenia, Bosnia and Herzegovina, Macedonia and the Republic Sprska. Croatia took at least 12, including a captured example. One is known to have flown ground-attack missions with rockets. Others were used for reconnaissance duties. The prototype was destroyed by NATO bombing in March 1999 as was an aircraft being rebuilt as the UTVA-75R prototype and at least two others.

After the wars, the Serbian Air Force based them at Batajnica with the roles of giving basic training to cadets and continuation flying for staff officers, and they served with Croatia's UHRZ Millitary School at Zemunik AFB. Slovenia handed theirs back to civilian aero clubs.

Although it is thought than fewer than a dozen remain airworthy in the former Yugoslavia, The U-75 has turned up in the military service of two African air arms. Sudan acquired up to six examples in 2009. Consideration was given to local production and one or two aircraft were modernised by the SAFAT Aviation Group, but the type is believed to now be out of service.

The unrecognised state of Somaliland has established an air force and in late 2024 showed off four UTVA-75s. They are believed to be in service with the Somaliland Aviation Academy in unarmed configuration. ■

UTVA-75A21

Crew: Two
Length: 23ft 4in (7.11m)
Wingspan: 31ft 11in (9.73m)
Height: 10ft 4in (3.15m)
Empty weight: 1,510lb (685kg)
Max T/O weight: 2,116lb (960kg)
Powerplant: One Textron Lycoming IO-360-B1F flat-four piston engine rated at 180hp (134kW)
Max speed: 133mph (215km/h)
Service ceiling: 13,125ft (4,000m)
Range: 497 miles (800km)
Armament: Two hardpoints for fuel tanks, gun pods, rocket launchers or up to 440lb (200kg) of bombs

Epsilon 11403 is one of 11 still in service with the Força Aerea Portuguesa at Beja. FAP

Aérospatiale (SOCATA) Epsilon

French Teacher

Derived from a four-seat light plane, the Epsilon had modest export success as a trainer

The Armée de l'Air issued a specification for a new primary trainer in May 1978. This called for an aircraft weight around 1,200kg (2,646lb), a 300hp (224kW) engine (preferably a non-turbocharged piston) and tandem seating. Contenders included the Beech T-34C, SIAI-Marchetti SF.260 and NDN-1 Firecracker, but a French solution was always the most likely. Development of a two-seat trainer by SOCATA, the general aviation arm of Aérospatiale, began in 1977 on the basis of the TB 10 Tobago four-seat light aircraft.

The TB 30 was shown in model form at the 1978 Farnborough Air Show. A contract was awarded in June 1979 for two flying and two static test examples of the Avion de Début Futur (ADF), although a contract for 150 aircraft for the Armée de l'Air was not signed until May 1981.

Marc Yoh and Claude Durand flew TB 30 No. 01 on 22 December 1979. The type was named Epsilon, the Greek letter E, which also stands for École (school), used as the French designation for training aircraft.

Designed with load factors of +6.7 to -3.35g and an estimated 10,000hr flying life, the Epsilon is of all-metal construction apart from polyester-covered elevator and rudder surfaces. Testing of the prototype found serious stability problems in some flight regimes. To fix this the tail surfaces were completely revised, with a larger swept-back fin fitted and the tailplane moved from a position above the rear fuselage to one near the bottom. A fixed strake was added under the tail and the wingtips were given an elliptical shape. There are no ejection seats but the canopy can be explosively jettisoned in an emergency.

From September 1984 the Epsilon trained both Armée de l'Air and Aéronavale pilots, initially on a 70hr course with GE 314 at Tours and GE 315 at Cognac. An aerobatic team from Cognac operated as the 'Cartouche Doré' with three Epsilons from 1989 until 2016. France's Epsilons were retired in 2019, replaced by Grob 120s.

Only three other operators have flown the Epsilon. OGMA in Portugal assembled 18 for the Portuguese Air Force. The first were delivered in 1989 and 11 are still in service with Esquadra 101 at Beja. The Togolese Air Force (Force Aérienne Togolaise) received five, although one was written off in 2017. The type was inactive, but two were brought back into service in 2021 and are part of the air group based at Lomé. Senegal's Air Force (Armée de l'Air du Sénégal) operates between six and eight TB 30s with l'École de l'Armée de l'Air at Thiès. ■

Aérospatiale TB.30B Epsilon

Crew: Two
Length: 24ft 11in (7.59m)
Wingspan: 26ft 0in (7.92m)
Height: 8ft 9in (2.66m)
Empty weight: 2,055lb (932kg)
Max T/O weight: 2,755lb (1,250kg)
Powerplant: One Textron Lycoming AEIO-540-L185D rated at 300hp (224kW)
Max speed: 236mph (378km/h)
Service ceiling: 23,000ft (7,010m)
Range: 777 miles (1,250km/h)
Armament: Provision for hardpoints for 661lb (300kg) of fuel or weapons

T-27
FAB 1384
FORÇA AÉREA BRASILEIR
SALVAMENTO

FAB EMB-312s in service at Campo Grande in 2004. FAB

Embraer 312 Tucano

The Birds from Brazil

Brazil's Tucano became one of the most successful of its generation, selling to countries around the world as both a trainer and light combat aircraft. In the latter role it saw more action, including aerial victories, than many dedicated fighter and attack jets.

In an effort to reduce reliance on foreign, particularly US, equipment the Brazilian government commissioned state-owned planemaker Embraer to develop an advance trainer to replace the Cessna T-37C jet. Although the Brazilian Air Force would have preferred another side-by-side jet configuration, the EMB-312 or T-27 emerged as a tandem-seat turboprop.

On 16 August 1980 the YT-27 flew at São José dos Campos in the hands of Luis Fernando Cabral and Gilberto Ideo Otaka.

Named Tucano (toucan), the EMB-312 was powered by a PT6A-25C turboprop and a four-bladed Hartzell constant-speed reversible propeller. The pilots sat in an unpressurised cockpit on Martin-Baker Mk. 10 ejection seats under a frameless side-opening canopy. Structure was predominantly metal with limits of +6 to -3g; airframe life was given as 6,000 hours.

Embraer delivered 463 production aircraft,

not including the Short Tucano, described separately. The Força Aérea Brasileira (FAB) was unsurprisingly the first and largest operator, taking an eventual 133 T-27s with the first delivered to the Air Force Academy in September 1983. They also equipped the Esquadrilha da Fumaça ('Smoke Squadron') aerobatic team from 1983 until 2012. Armed and camouflaged examples were issued to the 2nd Esquadrilha de Ligação e Observação (ELO; liaison and observation squadron) from 1987, and later to other units. Under the Amazon Surveillance System (SIVAM) they were used to destroy clandestine runways used by smugglers and to intercept suspicious aircraft. Under Operations Anaconda in 1991 and Green Carpet in 1999 Tucanos engaged Colombian FARC rebels operating inside Brazilian territory. The armed Tucanos were replaced by AT-29 Super Tucanos in 2008, but 33 T-29s remain in FAB service for training.

After the Falklands War, Argentina urgently required a weapons-capable trainer to replace the MS.760 Paris and selected the the EMB-312. The Brazilian Air Force supplied 15 newly built aircraft in mid-1987 and a further 15 were later delivered from the factory. They were assigned to Grupo Aérea Escuela at the Escuela de Aviaçion Militar at Córdoba.

Fuerza Aérea Argentina (FAA) Tucanos were equipped with weapons pylons but not armed until recent years when they were replaced in the training role by Texan IIs and shifted to a new unit tasked with intercepting smuggling flights and counterinsurgency missions, Escuadrón Operativo II Tucano at Reconquista.

Under a 1992 contract, Colombia purchased 14 armed Tucanos for training , but the increasing insurgency in the country saw them diverted to combat duties with Escuadrón de Combate 212 at Apiay. They frequently conducted close air support (CAS) missions with gun pods, rockets and bombs against the FARC rebel group. On occasion, up to ten aircraft at once made attacks on FARC encampments. The Tucano was also employed against drug smuggling aircraft and shot down one in 1999, later destroying others on the ground. With the arrival of the first Super Tucanos in 2016, the EMB-312s were gradually reassigned to the operational conversion role, having undergone structural upgrades including replacement of landing gear.

Egypt signed a licence-production deal with Embraer in late 1983, covering 40 aircraft for the Egyptian Air Force and 80 for Iraq to be built in the Kader factory near Heliopolis. Later this assembly line would move to Helwan as it had the advantage of being at an airport. Total Egyptian production would reach 124. Although used mainly for training by the 101st Air Brigade at Bilbeis, EAF Tucanos were tested with external loads and one crashed due to structural failure while carrying Soviet-designed weapons.

The first Egyptian-built aircraft were delivered to Iraq in 1985, replacing Aero L-29 Delphin jets for intermediate training at the Air Force Academy at Tikrit. About half of the 80 aircraft were kept in reserve and rotated through the active fleet to even out airframe hours. Although most survived the 1991 Gulf War, many were destroyed by Coalition action in 2003.

France's purchase of the Tucano was in part reciprocal for the supply pf Panther and Esquilo helicopters for the Brazilian Army. The EMB-312F adopted some features from the Short Tucano including bird impact-resistance leading-edges and a relocated refuelling receptacle. A ventral airbrake was fitted as were improved air conditioning and propeller and canopy de-icing systems. Avionics were supplied by French manufacturers and the structure was beefed up.

Deliveries to the Armée de l'Air began in January 1995 to the École de l'Air at Salon de Provence and the Groupe École 315 at Cognac. French service was relatively brief and the Tucano was retired for budgetary reasons in

A Brazilian Air Force T-27 in special colours to mark 30 years of the type in FAB service. *Johnson Barros/FAB*

2009, with some donated to Mauritania and others on the US civil register.

The Mauritanian aircraft were refurbished in France and transferred in 2010-11. Using 12.7mm gun pods, they were soon in action against the local branch of al-Qaeda, striking near and over the border with Mali (with Malian permission). One of the five EMB-312Fs was lost in an accident and replaced by another ex-French example.

Honduras was the first export customer for the Tucano, which received 12 T-27s under some secrecy in 1985-86. Mainly employed on advanced and conversion training by the Academia Militar de Aviacion at Palmerola, the Fuerza Aérea Hondureña EMB-312s were also used for patrol, SAR and air defence missions. In April 2003 one shot down a drug-running Rockwell Aero Commander, and up to 40 more suspect aircraft have been destroyed since then. FAH Tucanos use FN twin 7.62mm machine-gun pods, and 70mm rocket launchers.

Iran's Revolutionary Guard Corps Air Force (IRGC AF) bought 15 in 1988 and based them at Isfahan. As well as pilot training they have been used for internal security missions and have operated with rockets against Kurdish groups and (even more) Islamic extremists.

Paraguay purchased six aircraft in 1987, but lost two in accidents in 1995. A batch of six more was ordered, built and painted, but not paid for. Embraer sold them to Angola in 1998. Finally, in 2010, the PAF received three former Brazilian Air Force Tucanos.

Peru's 20 Tucanos were acquired in 1986 for training, but saw more active service than those of most other users. In 1989 Embraer began modifying several Fuerza Aérea del Peru (FAP) aircraft to mount gun pods, bombs and rockets to take an active part in the 'War on Drugs' as demanded by the US administration. Operating from dispersed locations they intercepted smuggling aircraft and shot down around half of the 40 destroyed by the FAP in 1995-2000 according to some sources.

In the brief Cenepa War with Ecuador in 1995, Peruvian Tucanos saw more combat, attacking Ecuadorian positions with Mk. 82 bombs, flying by night with the help of NVGs to avoid interception. They were phased out in favour of the KAI KT-1 by 2018,

Venezuela's 31 T-27 and AT-27 Tucanos were delivered in 1986-88 to the Escular Militar de Aviacion, replacing the Jet Provost trainer but also with a secondary light attack role.

In the first of two 1992 coup attempts, rebels captured some Tucanos, but did not use them in combat. In the second, rebel AT-27s took part in bomb and rocket attacks on the presidential palace and loyalist barracks, while government Tucanos strafed rebel columns. Most aircraft suffered damage and two rebel aircraft crash-landed before the coup failed. Around 18 EMB-312s remain active in the basic and tactical training roles, mostly with Grupo de Entrenamiento Aéreo 14 at Boca del Rio.

Angola's Tucanos were the last new EMB-312s delivered in 1998 and saw a lot of action in the latter part of country's civil war (1975-2002), mostly equipped with rockets. As well as attack missions they provided a reconnaissance capability that was instrumental in locating UNITA guerrilla bands and directing government troops to them. Survivors of the original eight were supplemented by six ex-Peruvian aircraft in 2002. Today they equip 16 Esquadra de Caça-Bombardeiros at Catumbela and the Esquadrilha de Reconhecimento at Luanda. ■

Embraer 312 Tucano

Crew: Two
Length: 32ft 4in (9.86m)
Wingspan: 36ft 7in (11.14m)
Height: 11ft 2in (3.40m)
Empty weight: 3,946lb (1,790kg)
Max T/O weight: 7,000lb (3,175kg)
Powerplant: One Pratt & Whitney Canada PT6A-25C turboprop rated at 750shp (560kW)
Max speed: 274mph (440km/h)
Service ceiling: 28,500ft (8,686m)
Range: 1,192 miles (1,918km)
Armament: Four underwing pylons with 2,204lb (1,000kg) capacity including Mk. 81 and Mk. 82 series bombs; 127mm or 70mm rockets; 12.7mm gun pods

Spain operated the Pillán as the E.26 Tamiz from 1987 until 2024. E.26-32 is now stored at Seville.
Ejército del Aire

Enaer T-35 Pillán

Latin Instructor

Developed with the help of US planemaker Piper, the Pillán has sold to numerous air forces in the Spanish-speaking world since the 1980s. An improved version is under development.

Chile's quest for a primary trainer to replace its Beech T-34As was hampered by arms embargoes against the Pinochet regime. The Fuerza Aérea de Chile (FACh) considered the CT/4 Airtrainer from New Zealand, but this fell through for political reasons.

Piper Aircraft, which had partnered with IndAer, the aircraft manufacturing arm of the FACh to build Cherokees in Chile developed a tandem-seat aircraft based on the PA-28 Dakota with some components from the PA-32 Saratoga. The first aircraft, N300BT, designated PA-28R-300XBT (experimental basic trainer), flew at Lakeland, Florida on 6 March 1981. It and a second prototype were shipped to Chile and subsequent aircraft were built at El Bosque by Empresa Nacional de Aeronáutica de Chile (Enaer) using Piper-manufactured kits and locally-made parts.

Designated T-35 Pillán (volcano spirit), the aircraft was a conventional light low-winged monoplane, powered by an Avco Lycoming AEIO-540 piston engine. It was notable for its large clear canopy. At the time, it's only western equivalent on the market was the Aérospatiale Epsilon.

The FACh acquired an initial 36 and eventually they received 60 T-35A basic trainers and 20 T-35B instrument trainers. Other operators have all been Spanish-speaking nations. The Spanish Air Force operated 41 Casa-assembled T-35Cs as the E.26 Tamiz which were operated by the Air Academy at San Javier until the 34 remaining aircraft were retired in 2024.

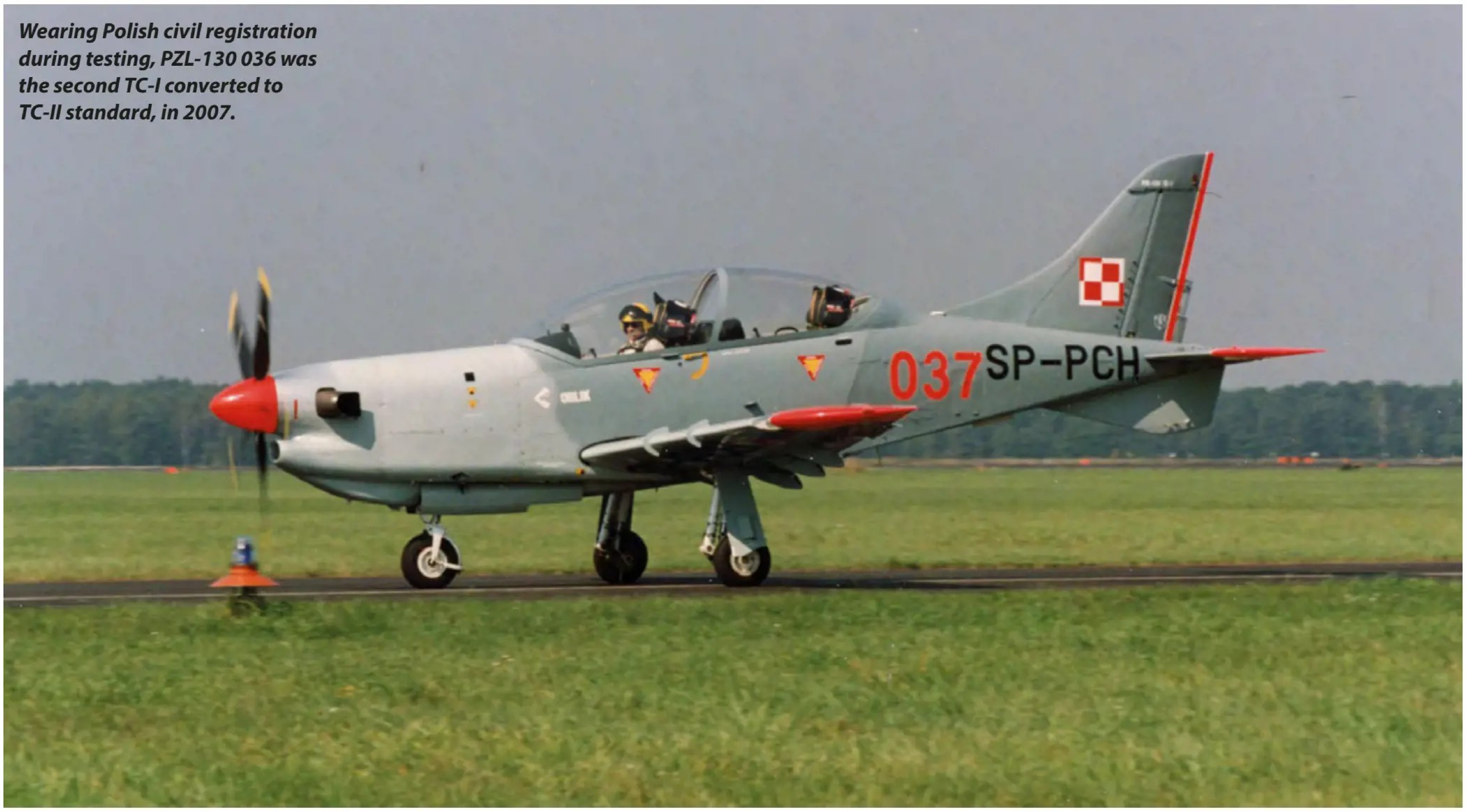
The Dominican Republic's Air Force (Fuerza Aérea Dominicana) replaced its remaining T-34Bs in use with the Aviation School with eight T-35Bs in 1999-2000. Of these, three are active, but their numbers have been supplemented by seven ex-Spanish Air Force T-35Cs. The National Air Service of Panama bought four T-35Ds and the Ecuadorian Navy has three currently being refurbished by Enaer. El Salvador uses a single-T-35A Pillán and three T-35B-3s, the survivors of five ex-Chilean aircraft delivered in the late 1990s and two new-build T-35As in 2005. Paraguay received nine T-35Ds, of which six were being upgraded by Enaer from 2023 to extend their life by a further 4,000 hours. New instrumentation including Garmin GTN 650xi navigation is being fitted.

A turbine version, the T-35TX Aucán flew in February 1996 with a 420shp (313kW) Allison 250-B17D turboprop. The Soloy Corporation of the US was contracted to produce a modification kit for piston Pilláns, which were marketed as the T-35DT or Turbo Pillán. This did not progress further and neither did a single-seat T-35S.

Although production of the baseline T-35 has ended, Enaer is developing the Pillán II which features a new wing with removable winglets, a slightly longer fuselage and a glass cockpit with a HUD. It is offered as part of an integrated training system with simulators and mission planning and debriefing systems. Enaer is under contract to deliver 33 Pillán IIs to the FACh to replace its aging T- 35 trainer fleet from 2027 and it is believed that the Uruguayan Navy has ordered four. ■

Enaer T-35A Pillán

Crew: Two
Length: 26ft 3in (8.00m)
Wingspan: 29ft 0in (8.84m)
Height: 8ft 8in (2.64m)
Empty weight: 2,050lb (930kg)
Max T/O weight: 2,950lb (1,338kg)
Powerplant: One Avco Lycoming AEIO-540-K1K5 flat six piston engine, rated at 300hp (224kW)
Max speed: 207mph (333km/h)
Service ceiling: 20,500ft (6,248m)
Range: 846 miles (1,361km)
Armament: Hardpoints for ISR equipment


Wearing Polish civil registration during testing, PZL-130 036 was the second TC-I converted to TC-II standard, in 2007.

PZL-130 Orlik

From Radial to Turboprop

Poland's Orlik trainer is a product of the Cold War, but continues in service with its one and only customer. It was one of the first trainers designed as part of a complete system, incorporating ground-based simulators and fault diagnostic equipment.

PZL (Państwowe Zakłady Lotnicze - State Aviation Works) had several plants in Poland, which produced various Soviet-designed aircraft and indigenous designs. To meet a 1981 Polish Air Force requirement the consortium's Warsaw factory PZL Warszawa-Okęcie competed with PZL Mielec, which offered the M-26 Iskierka. The former's prototype PZL-130 Orlik (spotted eaglet), flew on 12 October 1984. SP-PCA had a Russian Vedenyev M-14PM radial engine of 330hp (246kW), while second prototype SP-PCB used a PZL Kalisz engine. The se radial engines were enclosed under tight-fitting cowls to minimise drag. A third aircraft was fitted with a Pratt & Whitney Canada PT6A-25A turboprop as the PZL-130T Turbo Orlik in July 1986 but was lost an accident while being demonstrated to to the Colombian Air Force in January 1987.

Availability of western turboprops in Cold War Poland was clearly limited, but the supply of Russian piston engines was also unreliable and although other PT6-engined aircraft flew, development moved to a 750hp (560kW) Czech Motorlet M-601E turboprop.

The M-601-engined PZL-130TB flew in September 1991. Its avionics were of Russian origin and modelled around the cockpit of the Sukhoi Su-22 fighter. It has a side-hinged canopy with the rear seat raised. The pilots sat on Polish LFK-KI ejection seats. Components of the System-130, also known as Kolegium, were the Profesor simulator and the Inspektor electronic fault diagnosing device.

The first of PZL-130TBs entered service with the Polish Air Force in 1994. Some were also used by the Navy for a few years before reverting to Air Force control. A Westernised PZL-130TC for the export market was followed by the PZL-130TC II in 2000. This had Garmin avionics, a new wing with winglets and more powerful powerplant with the PT6A-25C engine and a four-bladed Hartzell propeller. The Polish Air Force bought 16 TC-IIs, which serve with 4. Skrzydło Lotnictwa Szkolnego (4.SLSz) at Radom and equip the air force's Team Orlik display team. A contract to modernise 12 TCIs to a common standard as the Orlik TC II Advanced was issued in 2020.

PZL-Warszawa-Okęcie was bought by Airbus in the early 2000s and continued to develop the Orlik. The Orlik MPT (Multi Purpose Trainer) flew in 2014 and features multi-functional displays, a HUD in the front cockpit and a repeater in the rear. The NVG-capable cockpit had Martin-Baker Mk 11L ejector seats. The Orlik MPT was promoted in Spain as a CASA C101 replacement, but lost out to the PC-21. ■

PZL-130TB Turbo Orlik

Crew: Two
Length: 29ft 6in (9.00m)
Wingspan: 29ft 6in (9.00m)
Height: 11ft 7in (3.53m)
Empty weight: 3,527lb (1,600kg)
Max T/O weight: 5,952lb (2,700kg)
Powerplant: One Motorlet M601E turboprop engine rated at 560hp (750kW)
Max speed: 311mph (501km/h)
Service ceiling: 33,000ft (10,060m)
Range: 523km miles (970km)
Armament: Four-shot 57mm rocket launchers for training

Ireland received eight PC-9Ms in 2004 and another in 2017 as a replacement for one lost in an accident. *Pilatus*

Pilatus PC-9

Turbo Trainer to the World

Almost as soon as the production PC-7 flew, Pilatus began work on an improved version that could perform additional missions such as tactical and weapons training and compete with jets for the advanced training role.

The PC-9 is larger and heavier than the baseline PC-7, and it was said that only ten per cent of components were common to both types. There is more commonality with the PC-7 Mk II, which uses the same fuselage and some other components. Changes included a new fuselage, enhanced engine performance, improved aerodynamics, and contemporary cockpit design with mainly digital instruments. The modified wing had larger ailerons, an airbrake was added and doors to cover the main undercarriage when retracted. This featured larger wheels with high-pressure tyres. Most noticeably, the rear cockpit was raised and a new canopy was fitted to give better visibility from the front seat. The crew were given Martin-Baker Mk 11A ejection seats.

The first flight of HB-HPA took place on on 7 May 1984, followed by HB-HPB with a more advanced cockpit on 20 July. Export orders soon came, although not in as large numbers as the PC-7. Operators are or have been: Angola (four PC-9); Australia (67 PC-9/A); Bulgaria (six PC-9M); Chad (one PC-9M); Croatia (17 PC-9M); Cyprus (two PC-9); Iraq (20 PC-9); Ireland (eight PC-9M); Mexico (two PC-9M); Myanmar (ten PC-9); Oman (12 PC-9M); Saudi Arabia (50 PC-9); Slovenia (nine PC-9M); Switzerland (14 PC-9); Thailand (36 PC-9); US Army (three PC-9). The German government acquired ten PC-9Bs for target towing fitted with two Southwest RM-24 winches on the inner pylons. These reeled out banners used as targets mainly for Gepard mobile gun systems.

Saudi Arabia was the first customer, signing for an initial ten in 1985, which were prepared for delivery by British Aerospace in the UK. The Australian government ordered 63 as the PC-9/A in 1985. These had a Bendix cockpit and low-pressure tyres. After delivery of two Swiss-built aircraft and 17 kits, the remaining were built by Hawker de Havilland at Bankstown, NSW.

As well providing basic flying instruction with No. 2 FTS at RAAF Pearce, Western Australia, they equipped No. 1 FTS and the Central Flying School (CFS) at East Sale, Victoria, which was also the home of the Roulettes aerobatic team. No. 76 Squadron and later, No. 4 Squadron used the type to train forward air controllers (FACs). After retirement from RAAF service in 2020, six PC-9/As were sold to US contractor Blue Air Training. The company uses them for FAC training armed with practice bombs, laser-guided training round, seven-round rocket launchers and 7.62mm gun pods.

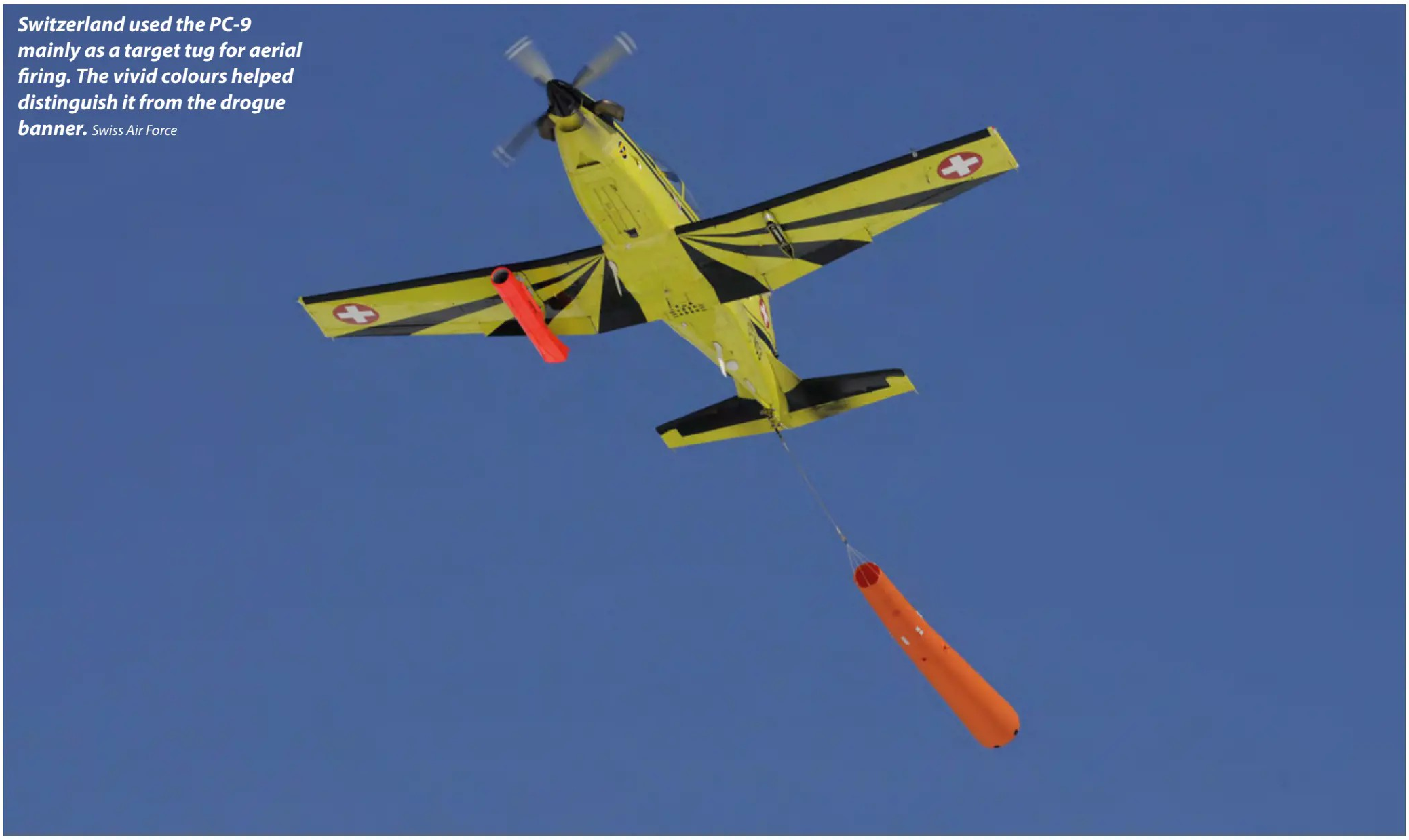
Slovenia's aircraft are known as the Hudournik (Swift) and are operated as dedicated weapons trainers with six underwing hardpoints, which are used for HMP-250 12.7mm gun pods; LAU-7A seven-round unguided rocket launchers;

Pilatus PC-9

Crew: Two
Length: 33ft 3in (10.13m)
Wingspan: 33ft 5in (10.18m)
Height: 10ft 8in (3.26m)
Empty weight: 3,802lb (1,725kg)
Max T/O weight: 7,054lb (3,200kg)
Powerplant: One Pratt & Whitney Canada PT6A-62 turboprop, flat rated at 950shp (708kW)
Max speed: 368mph (593km/h)
Service ceiling: 38,000ft (11,580m)
Range: 955 miles (1,537km)
Armament: Three hardpoints for up to 551lb (250kg) stores each

HB-HPA was the prototype PC-9, first flying in May 1984.

Thailand bought 36 PC-9s, including this one, which was written off in 1992. *Jim Winchester collection*



Switzerland used the PC-9 mainly as a target tug for aerial firing. The vivid colours helped distinguish it from the drogue banner. *Swiss Air Force*

dispensers for IBDU-33 practice bombs and a laser rangefinder pod. Ireland's PC-9Ms are pilot trainers which have a secondary weapons capability using rocket and gun pods.

The PC-9M was introduced in 1997. It has an enlarged dorsal fin fairing to improve longitudinal stability and reduce stick forces; modified wing-root fairings to improve low-speed characteristics; and 'exciter strips' on the wing leading-edges for better stall characteristics. A new engine/propeller control system separates flight idle and ground idle modes, reducing acceleration time and improving handling.

Combat use of the PC-9 has been limited. Chad's aircraft were reportedly used against rebel forces in the 2000s. The crew of an Iraqi PC-9 ejected when intercepted by a USAF F-15C during the 1991 Gulf War.

A pair of PC-9/As of the RAAF's No. 4 Squadron on their last flight before retirement in 2019. Both these aircraft were allocated for static display. *Cpl Craig Barrett/RAAF*

As with the PC-7, Switzerland was initially reluctant to buy the PC-9, mainly because it had just bought the PC-7. After two were leased from Pilatus for trials, another 12 were purchased in three batches from 1988. The main Swiss role for the PC-9 was target towing, replacing the C-3605 Schlepp. Some aircraft also carried the Ericsson Vista 5 jamming pod as part of electronic warfare training for ground-based air defence forces. Operated by Zielflugstaffel (Target Squadron) 12, the yellow-painted PC-9s were retired in late 2022 and not replaced in the target-towing role, while the jamming pods were transferred to the F-5 fleet.

Pilatus competed for the USAF/USN JPATS competition with the PC-9 Mk II. This was said to be a 70 per cent redesign of the PC-9, including a strengthened fuselage and a pressurised cockpit. New systems included a GPS, collision avoidance and provision for a HUD. Beech at Wichita, Kansas was the US partner, and the first example built there flew on 23 December 1992. Evaluation by the USAF began in July 1994 at Wright-Patterson AFB, Ohio.

Selected in 1995, it evolved into the Beech T-6 Texan II, which diverged even further from the PC-9. Although still being marketed, the 265th and last aircraft built to date was a PC-9M delivered to Ireland in 2017. The older PC-7 has outlasted it in production while adopting many PC-9 features. ■

Although the G115 is not blessed with an excess of power, the RAF's Grob Tutor Display Team has performed many solo aerobatic display routines at venues around the UK. Jim Winchester

Grob 115 Tutor

Plastic Fantastic

The all-composite G115 basic trainer has sold to air arms from Finland to Egypt, with the largest user being the Royal Air Force which operated nearly 100 at one time.

Formed in 1971, German manufacturer Grob Aerospace GmbH was best known for its sailplanes and motor gliders, including the G103 Viking and G109 Vigilant, which were used by the RAF's Volunteer Gliding Schools. The Grob G115 which first flew in 1985 was the company's first traditional powered aircraft and initially sold to civilian flight schools and flying clubs. The basic structure is 96 per cent carbon fibre and the aircraft is capable of aerobatics up to +6G and -3G.

In the 1990s the UK armed forces contractorised their basic flying training under a public-private partnership deal using 99 G115Es. Named after the Avro Tutor biplane of the 1930s, the Tutor T.1 replaced the Bulldog in RAF service in 1998, initially with No 1 Elementary Flying Training School (EFTS). Later they came under the banner of No. 6 FTS. In 1999 the Central Flying School (CFS) at Cranwell received its first Tutor. Instructor training takes place at RAF Wittering with No. 115 Squadron, and training standards and evaluation are conducted by No. 16 Squadron at the same base.

The Tutor is assigned to 15 University Air Squadrons (UAS) which teach young people about service life and leadership while giving them flight training to solo standard. They are also used by Air Experience Flights to provide flying experience to cadets of the Air Training Corps and Combined Cadet Force. The Tutors were purchased and operated by VT Aerospace (now Babcock), with military instructors and civilian contractors handling maintenance.

The Royal Navy and Army Air Corps used the G115 for flying grading before progression to elementary flying training. The initial RN version was the G115D2 Heron with a 160hp (119kW) Lycoming AEIO-320-D1B engine and mainly glassfibre structure. Only six Herons were built and were later sold to civilian operators. The Navy now uses the Tutor with Nos 703, 705 and 727 Squadrons.

In the Tutor the student or solo pilot sits on the right so that the throttle is in the left hand and stick in the right as it will be in frontline aircraft. The large bubble canopy and windscreen provide a good view for the occupants, although the thick canopy bow could create blindspots.

Tutors suffered from a series of propeller hub failures with subsequent forced landings and the fleet was grounded twice, in 2004 and 2013, although soon returned to service. The particular engine and propeller combination was unique to the British aircraft.

Production of the G115 exceeded 370 and they have served with a number of other air arms. The Egyptian Air Force has 74 G115EGs with Nos 3 and 5 Squadrons at Bilbays; the AIr College Squadron at Al Ain in the United Arab Emirates operates 12 G115TAs; Kenya has three G-120A-Ks with the Flying Training Squadron at Nanyuki and Bangladesh flies two at Jessore with No.12 Squadron. Finland bought 28 ex-RAF aircraft from Babcock in 2016-18 and refitted them with digital cockpit instrumentation for use at the Air Force Academy at Tikkakoski. ■

Grob Tutor T.1

Crew: Two
Length: 25ft 7in (7.79m)
Wingspan: 32ft 10in (10.0m)
Height: 9ft 3in (2.82m)
Empty weight: (670kg)
Max T/O weight: (990kg)
Powerplant: One Textron Lycoming AE-360-B four-cylinder piston engine rated at 180hp (134kW)
Max speed: 213mph (343km/h)
Service ceiling: 10,000ft (6,095m)
Range: 513 miles (826km)
Armament: None

A Tucano T.1 of No. 207 Squadron flies above Yorkshire. ZF204 last flew in August 2018 and is awaiting disposal. Jim Winchester

Short Tucano

From Brazil to Britain

The Short Tucanos had many changes to their Embraer-built counterparts, not least a new engine. They served the RAF faithfully for more than 30 years, but had limited export success.

Air Staff Target 412 was issued in 1984 as a requirement for a high-performance turboprop to replace the ageing Jet Provost as the RAF's intermediate and advanced training platform. The contenders were the Australian Aircraft Consortium (AAC) A.20 Wamira II, the British NDN-1T Turbo-Firecracker, the Swiss Pilatus PC-9 and the Embraer/Shorts Tucano. The seventh production EMB-312 was sent to Belfast for modification to meet the RAF specification, and was re-engined with the uprated 750hp (560kW) PT-6A-25C2 engine and given a ventral air brake to meet the critical stall speed requirement of 60kts (69mph/111km/h).

Evaluation by Aeroplane & Armament Experimental Establishment (A&AEE) at Boscombe Down found it fell short in several areas including the required time-to-height criteria. A new engine was chosen, the 1,100hp (820kW) Garrett TPE331-10 and with this, the performance markedly improved. With a price substantially cheaper than the PC-9, the Tucano was declared the winner of AST-412 in March 1985 almost a year before the re-engined aircraft flew at Gavião Peixoto in February 1986.

The Short Tucano built in Belfast had more than 900 changes compared to the standard EMB-312 including a strengthened airframe for improved fatigue life, a revised cockpit layout to reflect that of the BAe Hawk, a revised oxygen system, a flight data recorder and restyled wingtips. The aircraft was also fitted with a pair of Martin-Baker MB 8LC ejection seats with the canopy modified to meet the RAF's bird strike specifications.

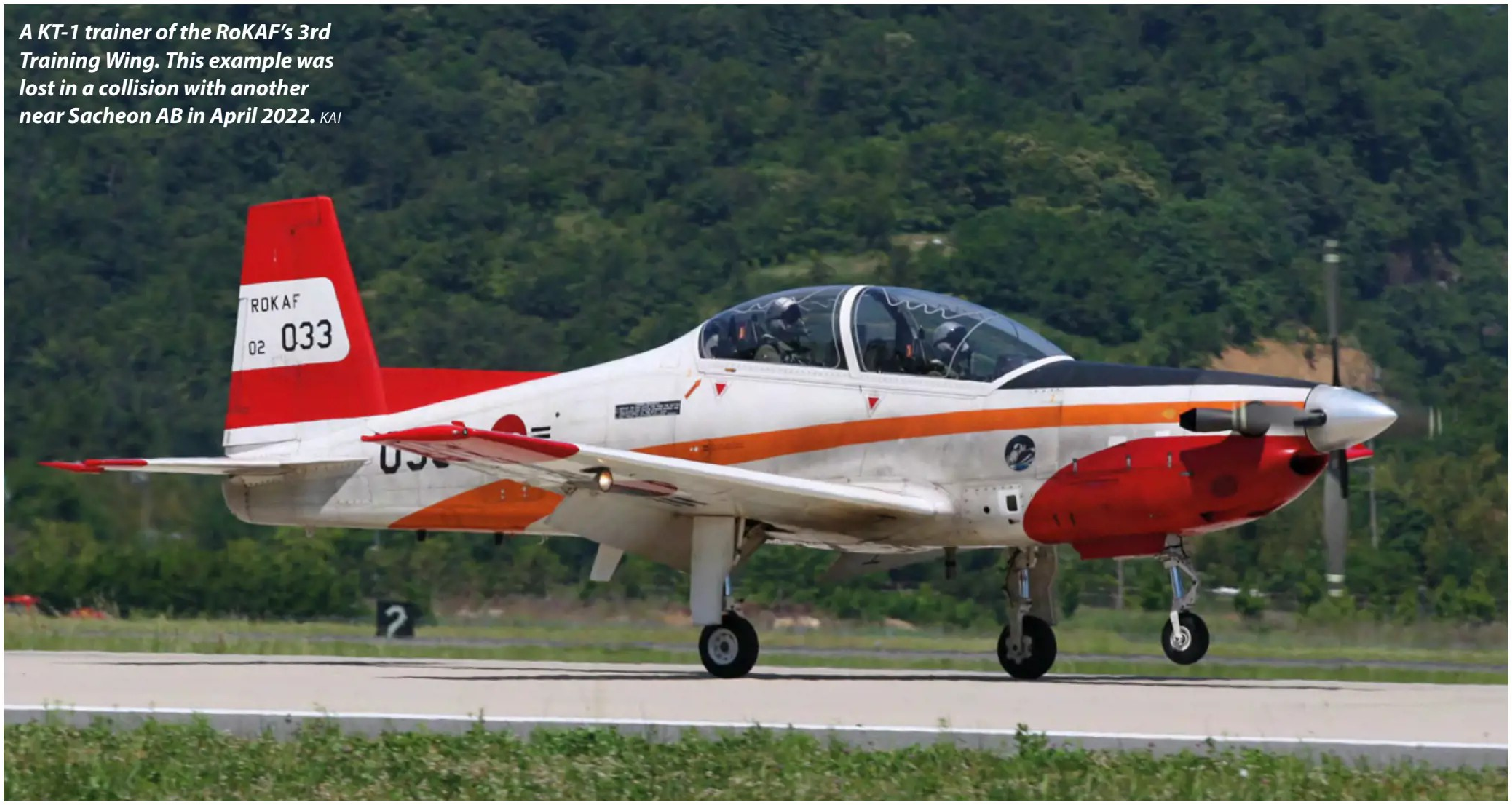
On December 30, 1986 the first production aircraft for the RAF, ZF135, undertook its maiden flight. Entering service in June 1988 with the Central Flying School (CFS) at RAF Scampton, the Tucano T.1 was also issued to Flying Training Schools (FTSs) at Cranwell, Lincolnshire; Linton-on-Ouse; Finningley and Church Fenton (all in Yorkshire). No. 6 FTS at Finningley was charged with fast jet navigator training for future Tornado pilots. From 1995, basic training was consolidated with No. 1 FTS at Linton-on-Ouse. Its two component flying units were designated 72(R) and 207(R) Squadrons in 2002. Tucanos were also used to train forward air controllers, having similar performance to the Reaper UAV or the A-10 Thunderbolt II attack aircraft.

The only other customers of the Short Tucano were Kenya, which bought 12 T.51s with weapons capability of which 11 are still in use with the Flying Training Squadron at Nanyuki, and Kuwait which ordered 16 T.52s, delivered from 1995. These served with 19 Squadron at Ali as Salem, but appear to now be in flyable storage.

RAF Tucanos were concentrated in No. 72 Squadron from 2012, the unit having up to 40 aircraft on strength until it was disbanded and the type retired in October 2019. Up to 30 were sold in the USA, with 11 used by RSW Aviation in Arizona on military training contracts. ■

Short Tucano T.51

Crew: Two
Length: 32ft 4in (9.86m)
Wingspan: 37ft 0in (11.28m)
Height: 11ft 2in (3.40m)
Empty weight: 4,872lb (2,210kg)
Max T/O weight: 6,470lb (2,935kg)
Powerplant: One Garrett TP331-12B turboprop engine rated at 1,100shp (820kW)
Max speed: 319mph (513km/h)
Service ceiling: 34,000ft (10,363m)
Range: 1,099 miles (1,767km)
Armament: Mk. 81 and Mk. 82 series bombs, seven-shot unguided rocket pods, 12.7mm machine-gun pods



A KT-1 trainer of the RoKAF's 3rd Training Wing. This example was lost in a collision with another near Sacheon AB in April 2022. KAI

KAI KT-1/KA-1 Woong-Bee

Korea's Great Leap Forward

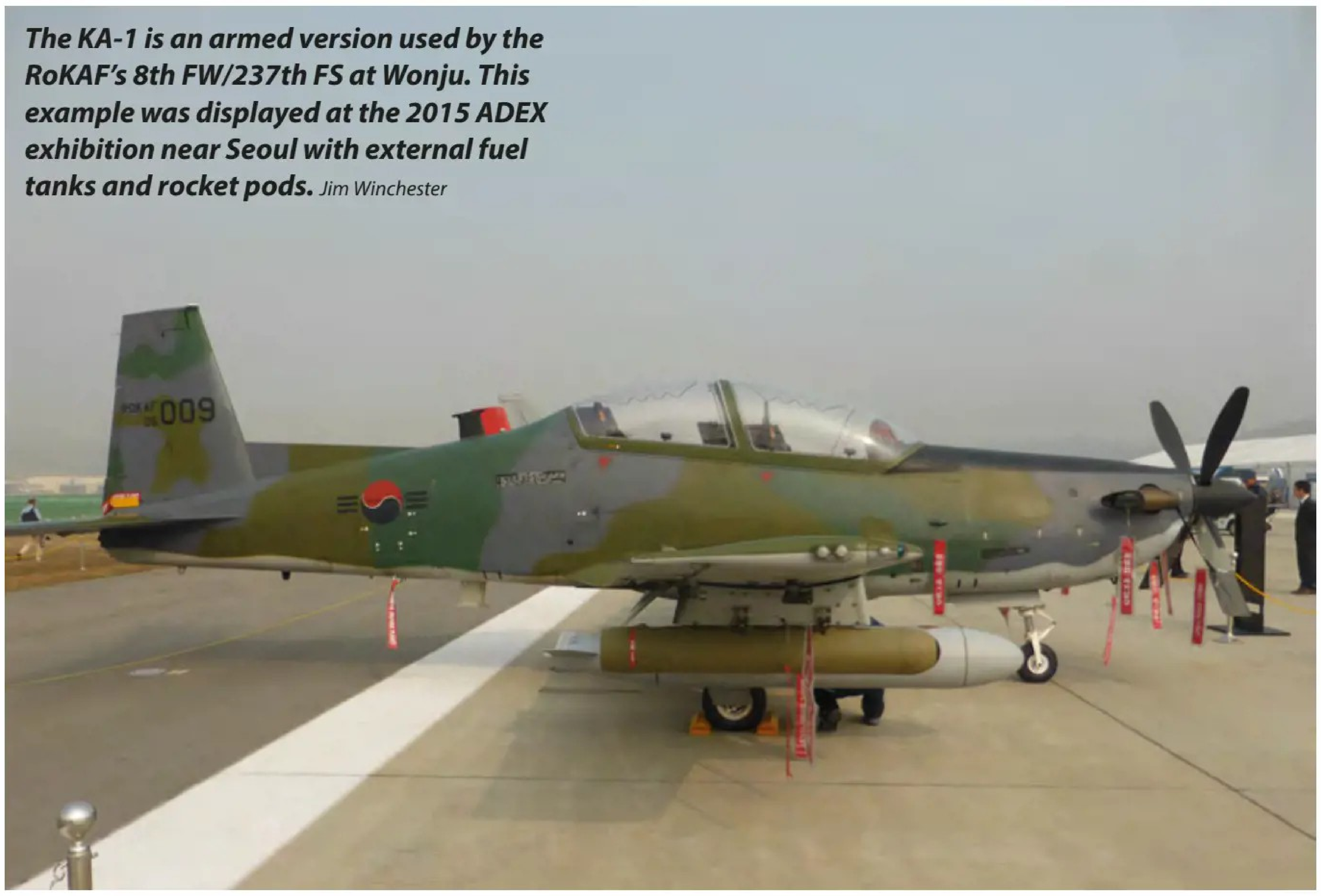
The KT-1 paved the way for South Korea's military aircraft industry, which today produces everything from helicopters to advanced fighters. It was the first Korean military aircraft to enter production and the first Korean design to be exported.

The Woong-Bee (Great Flight or Great Leap), sometimes spelled Woong-Be or Woongbi arose from a South Korean government programme to boost the aerospace sector. Under the Agency for Defense Development (ADD), Daewoo Heavy Industries was the prime contractor for a trainer to replace both the Cessna T-41 and T-37. As the KTX-1, the first of five prototypes flew in December 1991 and the last in 1998. The first two had the 550shp (410) Pratt & Whitney Canada PT6A-25A turboprop.

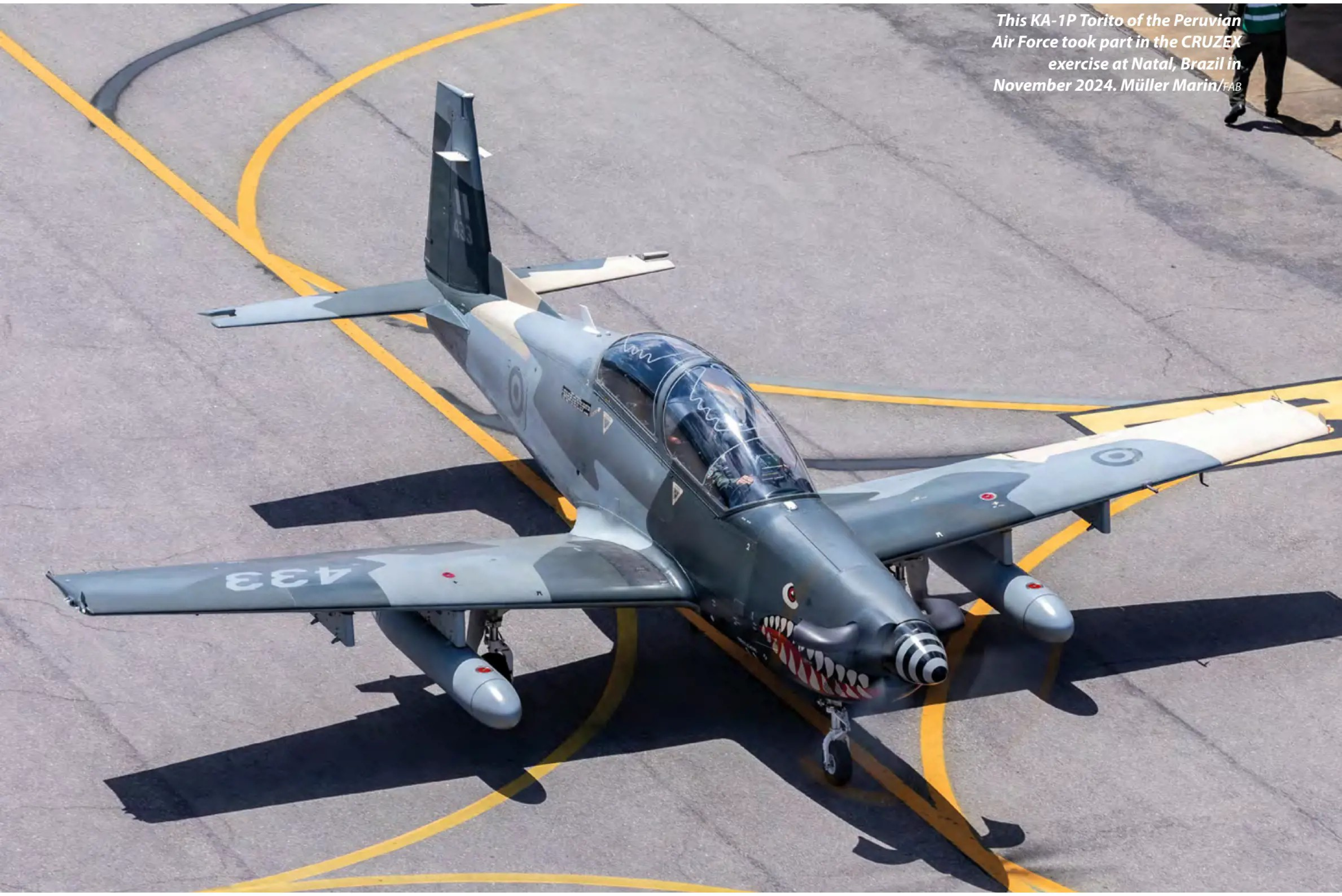
The second prototype had an enlarged dorsal fin, a two-part hinged canopy and lightweight ejection seats. Instrumentation was mainly analogue.

Production KT-1s were slightly larger and heavier, the horizontal tail surfaces were relocated to a lower position and they had a 950shp (708kW) PT6A-62 engine. They are fully aerobatic and stressed to +7 and -3.5g. Fuel efficiency and excellent spin recovery are features touted by the manufacturer, which In 1999 became Korea Aerospace Industries (KAI), formed as a joint venture between Daewoo, Samsung Aerospace and Hyundai Air and Space.

KAI developed an armed version for light attack and forward air control. The KA-1 has HUDs, up-front control panels, and MFDs with avionics supplied by Elbit, Flight Vision and Thales. It has five hardpoints capable of carrying rockets, gun pods and light AAMs. The central pylon can mount a forward-looking infrared (FLIR) sensor and a laser range finder.



The KA-1 is an armed version used by the RoKAF's 8th FW/237th FS at Wonju. This example was displayed at the 2015 ADEX exhibition near Seoul with external fuel tanks and rocket pods. Jim Winchester



This KA-1P Torito of the Peruvian Air Force took part in the CRUZEX exercise at Natal, Brazil in November 2024. Müller Marin/FAB

From November 2000 the Republic of Korea Air Force (RoKAF) received 103 85 KT-1s and from 2005, 20 KA-1s. The trainers serve with four squadrons of the 3rd Flying Training Wing at Sacheon and the attack versions with 237 Fighter Squadron at Wonju on forward air control and counterinsurgency duties.

Woong-bees have been sold to several nations. Indonesia's air force, the Tentara Nasional Indonesia-Angkatan Udara (TNI-AU) began using the KT-1 in 2003, replacing the T-34C.

The TNI-AU's 17 KT-1Bs differed mainly in their avionics, omitting some items and replacing others with commercial-off-the-shelf components. They are flown in the advanced training role by Skadron Pendidikan (SkaDik) 102 at Jogyakarta. The KT-1 also equips the Jupiter Aerobatic team with six aircraft flown by instructors from SkaDik 102.

Peru bought ten KT-1P trainers and ten KA-1P counter-insurgency aircraft in 2014; 16 of these were manufactured under license by local company SEMAN (Servicio de Mantenimiento de la Fuerza Aérea del Perú). The KT-1s are operated by Escuadrón Aéreo de Entrenamiento Básico 512 and the KA-1s by Escuadrón Aéreo de Entrenamiento Avanzada 513, both at Pisco. In FAP service the KT-1/KA-1 is named Torito (little bull). KAI also offered a similar licence-production deal to Paraguay, which eventually chose the Super Tucano.

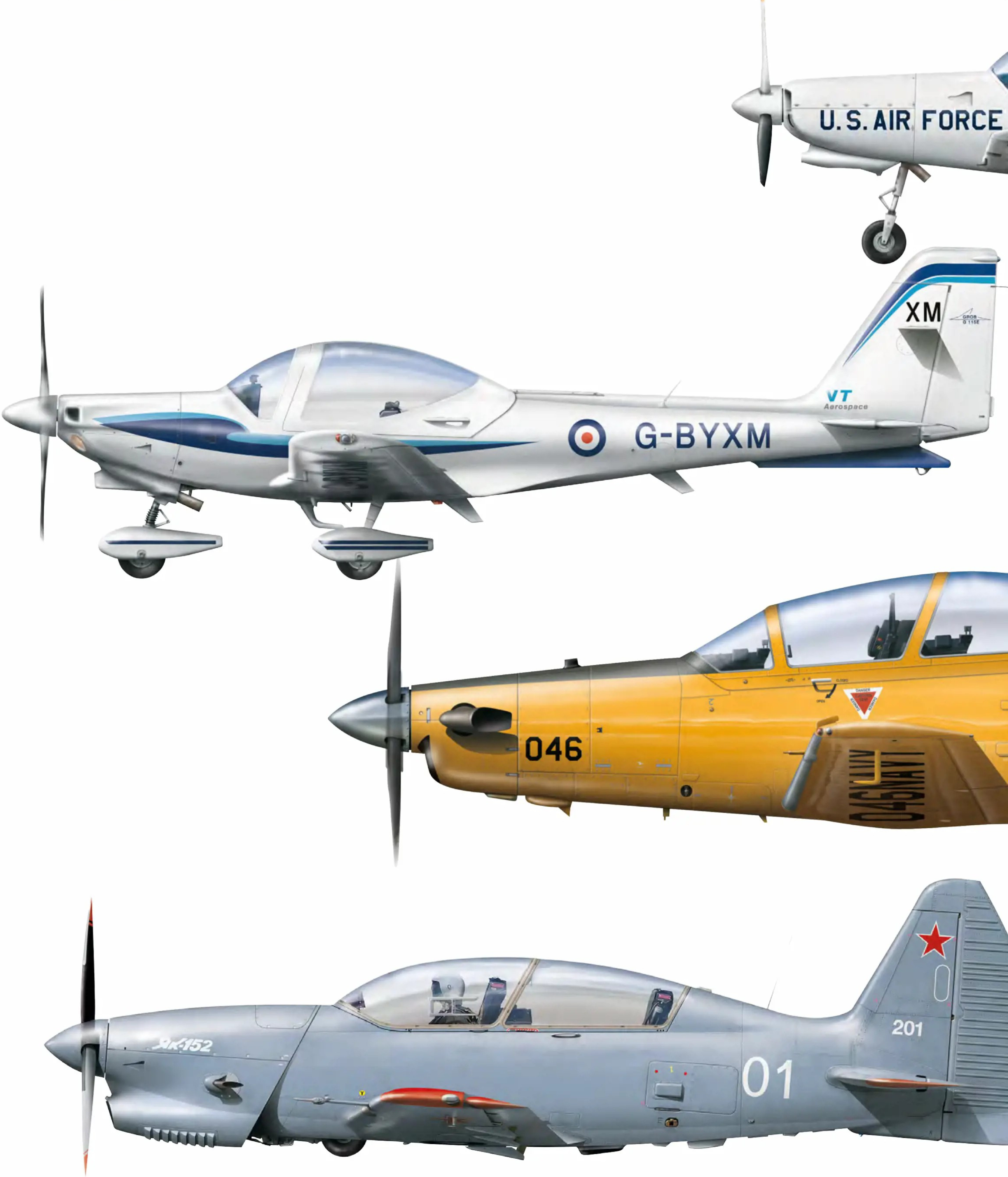
Senegal ordered four in July 2016, but the KA-1S were not delivered to the Escadron de Chasse at Dakar until June 2022. They are used both for training and for counterinsurgency missions.

Despite concurrent development of its Hürkuş trainer, Türkiye ordered 40 KT-1Ts, all but five of which were assembled by Turkish Aviation Industries (TAI). The first Korean-built example was rolled out in October 2010. Replacing Cessna T-37s, the KT-1Ts are ssigned to 122 Temel Filosu at Izmir, they have identical cockpit layouts to the Turkish Air Force's Northrop T-38M jet trainers, making transition from basic to advanced training smoother.

KAI has stopped producing the Woong-Bee, but in October 2025 an agreement was signed between KAT and PT Dirgantara Indonesia for the latter to set up a production line at Bandung and provide maintenance services for existing operators. Currently there are no orders, but Indonesia previously expressed interest in acquiring more KT-1s. ■

KAI KT-1 Woong-Be

Crew: Two
Length: 33ft 8in (10.26m)
Wingspan: 34ft 9in (10.59m)
Height: 12ft 1in (3.68m)
Empty weight: (4,210lb) (1,909kg)
Max T/O weight: 7,300lb (3,311kg)
Powerplant: One Pratt & Whitney Canada PT6A-62 turboprop rated at 950hp (708kW)
Max speed: 402mph (649km/h)
Service ceiling: 37,000ft (11,290m)
Range: 1,035 miles (1,666km)
Armament: None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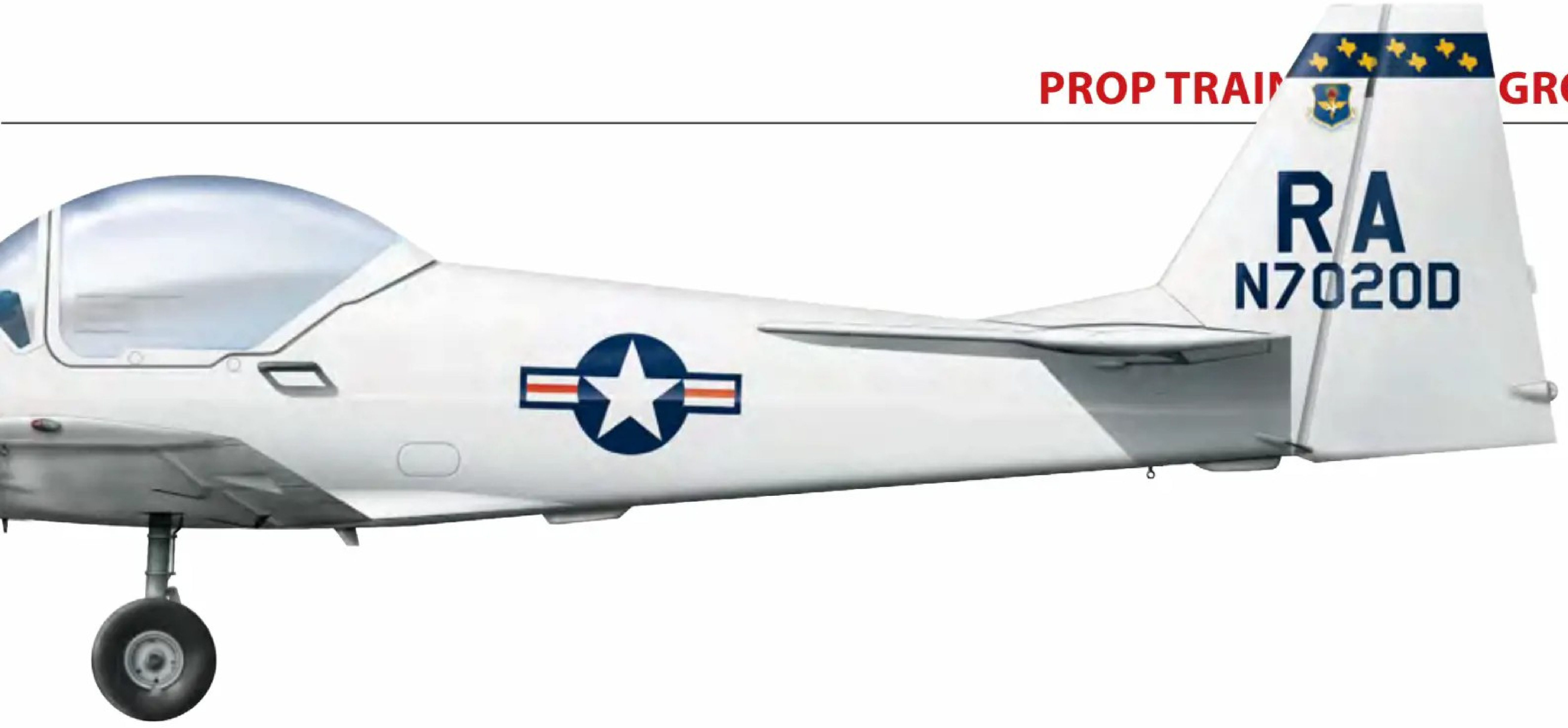
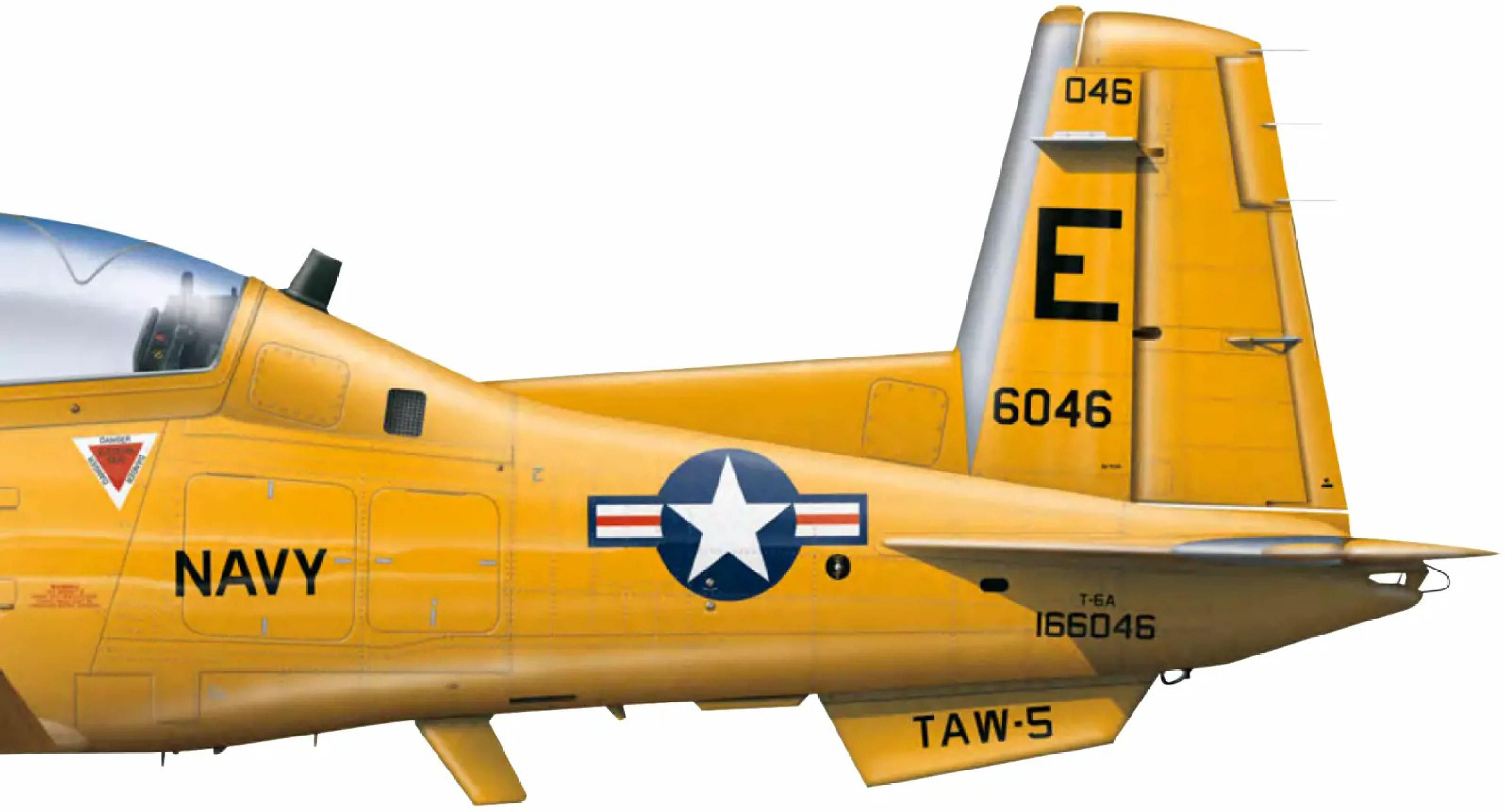




Slingsby T-3A Firefly
N7020D/92-0625, C/N 2109
Air Education and Training Command
USAF Flight Academy, Colorado Springs, Colorado

This Firefly made the first flight of a USAF T-3A on 4 July 1993. The T-3As wore dual military and civil registrations and by mid-1998 N7020D was assigned to 3FTS at Randolph AFB, Texas. In 1999 it was one of seven T-3s found to have unsatisfactory skin/rib bonding and was modified. The Firefly fleet was retired after several accidents and by September 2006 all were scrapped.

Grob 115E Tutor T.1
G-BYXM C/N 82173/E
East Midlands University Air Squadron
RAF Cranwell, Lincolnshire 2001

Delivered to VT Aerospace Ltd. at Bournemouth in May 2001, Tutor G-BYXM was assigned to the East Midlands UAS, which also has the shadow identities No. 16(R) and No. 115(R) Squadrons

G-BYXM as been used as the Tutor solo display aircraft with a large roundel under the fuselage and has also worn a small sharks mouth under the nose and 'RAF 100' titles in 2018.

The contract holder has since changed to Babcock and G-BYXM has also served with the Southampton UAS.

Beechcraft T-6B Texan II
Bu No. 166046, C/N PN-37
VT-2, TAW-5, United States Navy
NAS Whiting Field, Florida, 2011

Delivered to Training Air Wing 5 (TAW-5) in 2010, T-6C 166046 was one of two Texans painted in retro colour schemes as part of the Centennial of Naval Aviation (CoNA) celebrations in 2011. This one wore overall yellow to represent the standard trainer scheme from the late 1930s Ito the 1950s. It was sas still in its 'Yellow Peril" scheme in 2016, but has since been put back in the standard white over red livery and continues to train students with TAW-5.

Yakovlev Yak-152
C/n 0001
Zhukovsky, Russian Federation 2016

The Yak-152 has been developed in parallel with the Hongdu L-7 in China since 2001. The first of four Russian prototypes flew at Irkutsk without markings on 29 September 2016 and was coded '01 White' by mid-2017. By this time the planned M-14 radial engine was out of production and it flew with a German-made Raikhlin Engine Developments A03T diesel engine. After state acceptance tests were completed in late 2023, an order for 150 Yak-152s was made, but these will probably have the Russian VK-650V turboshaft engine.

The USAF operates nearly 500 T-6As. This one is assigned to the 71st Flying Training Wing's 8th Flying Training Squadron at Vance AFB, Oklahoma.

Senior Airman Taylor Crul/USAF

Beechcraft T-6 Texan II

Textron's Swiss Banker

The T-6 is the most numerous training aircraft today with nearly 1,000 serving in the active fleets of a dozen nations. More than half of them are in the USA, thanks to the type winning the huge Joint Primary Aircraft Training System (JPATS) contract in the 1990s.

Pilatus teamed with Raytheon Beechcraft (now Textron Defense) to compete for JPATS with a version of the PC-9. To meet the requirements of JPATS required extensive changes, including cockpit pressurisation, improved bird-strike protection, zero-zero ejection seats and a single-point pressure refuelling capability. Other systems specified included an onboard oxygen-generating system (OBOGS) and ejection seats capable of accommodating a wider range of occupants, those in the 95th percentile of adults.

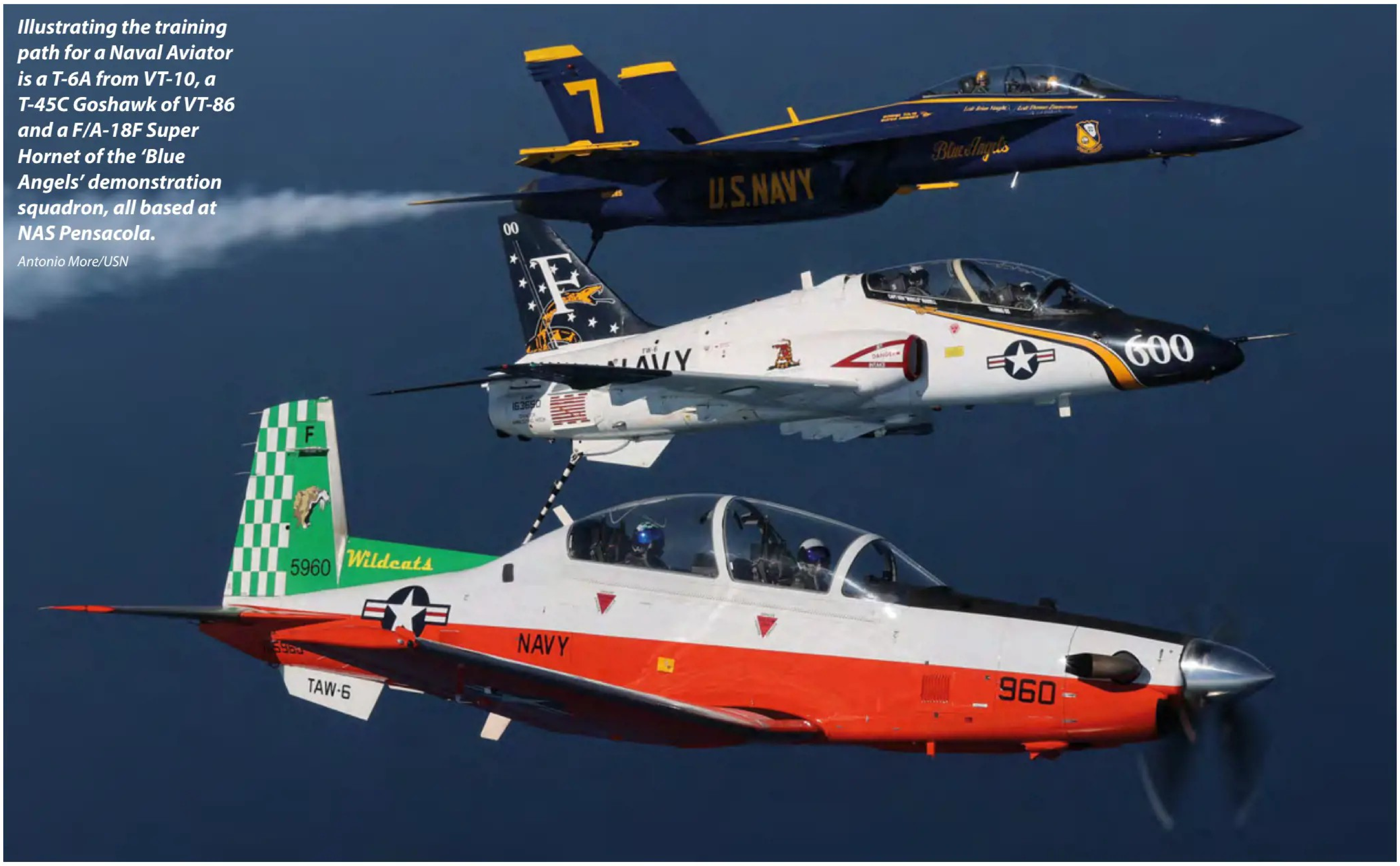
Beech modified two PC-9Ms to JPATS configuration in 1990-91, then built two new prototypes in 1992-93, the second of which was used for the actual evaluation. On 22 June 1995, the Beech entry was selected as the T-6 Texan II, in honour of the classic North American Texan. There were several protests from the other competitors, mainly over late changes in the specification that favoured turboprops over jets, and it was not until February 1996 that the contract was signed. The first operational aircraft arrived at Randolph AFB, Texas in May 2000 where instructor training began.

The USAF order for 442 T-6As was completed in 2010. They operate from training bases at Columbus AFB, Mississippi; Vance AFB, Oklahoma; Laughlin, and Sheppard and Randolph AFBs, Texas. The Euro NATO Joint Jet Pilot Training Program (ENJJPT) at Sheppard involves students or instructors from 14 nations.

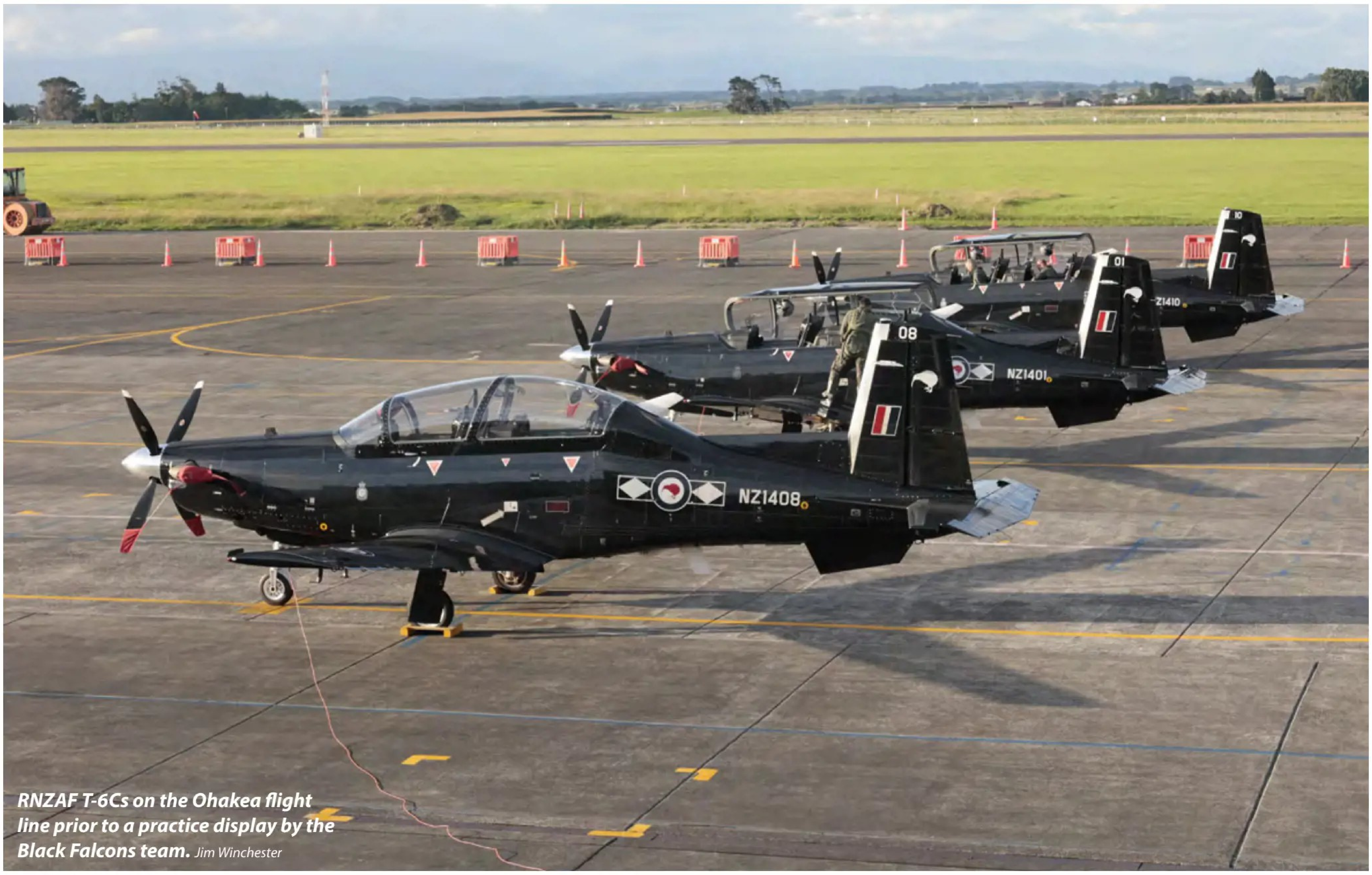
The US Navy's T-6As are mostly identical but for Aviation Life Support System (ALSS) equipment for over-water training. After 43 T-6As, the Navy acquired 252 T-6Bs with HoTaS controls, a widescreen HUD and larger MFDs. Maximum weight increased by 400lb (180kg). The Navy declared Interim Operational Capability (IOC) on the T-6A in 2003. They are based with training wings at NAS Pensacola and NAS Whiting Field, Florida and NAS Corpus Christi, Texas, and with the Test Pilot School at NAS Patuxent River, Maryland.

The US Army operates four T-6Ds at Redstone Arsenal in Huntsville, Alabama, for chase duties and other tasks including cloud physics research and stores component research and qualification.

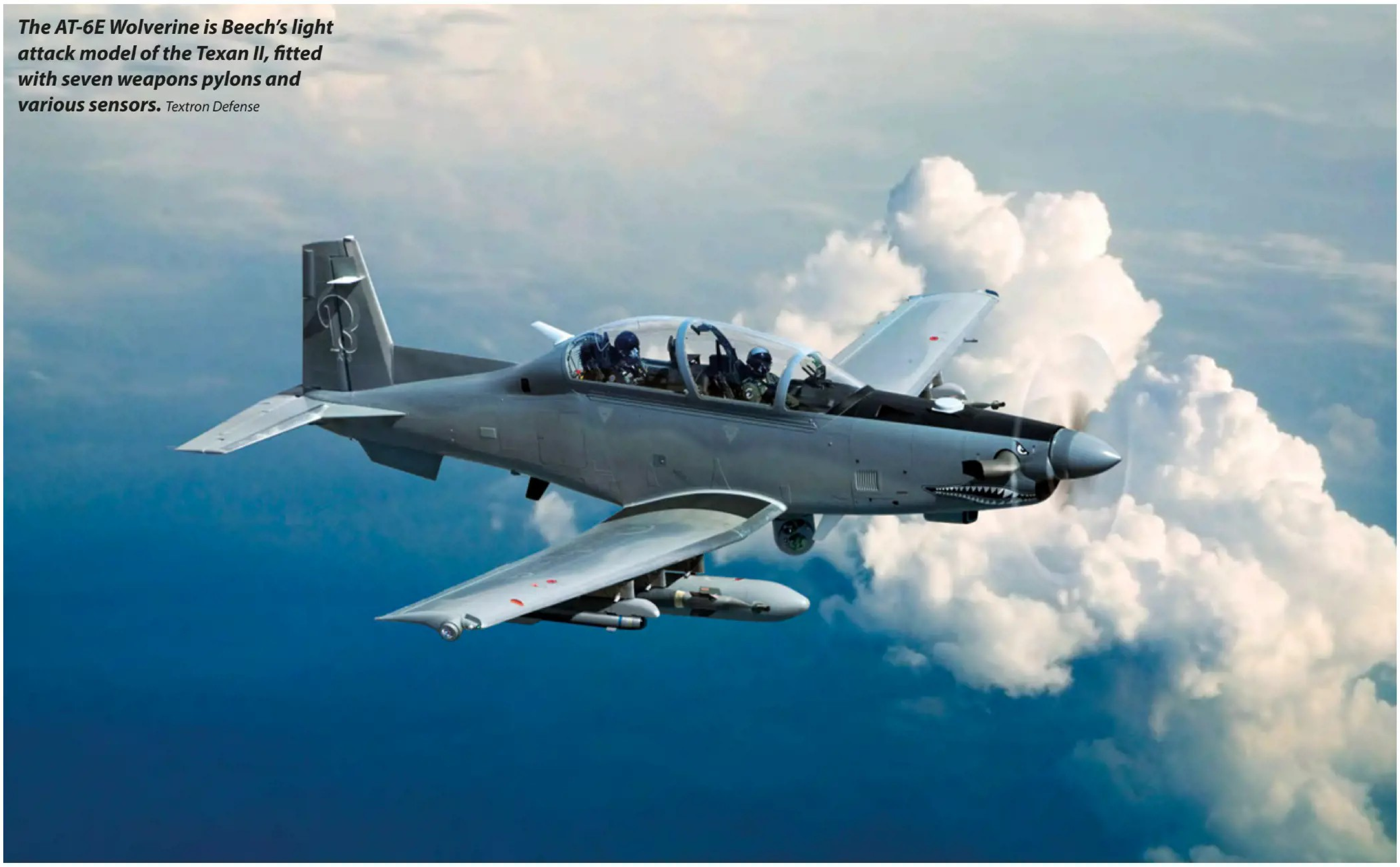
Although very similar in appearance, the PC-9 and T-6 have only about 30 per cent of their parts in common, with everything aft of the engine firewall strengthened. The most obvious visual differences are the separate windscreen on the T-6 and a large ventral fin below the tail. Unlike some trainer types such as the Tucano and PC-21 that have raised rear seats, the T-6 has level seats and some blind spots from the back. There is no head-up display (HUD) in the rear seat, just a repeater which takes up one of the MFD screens so is not a HUD in the true sense. Normally the panel is configured with



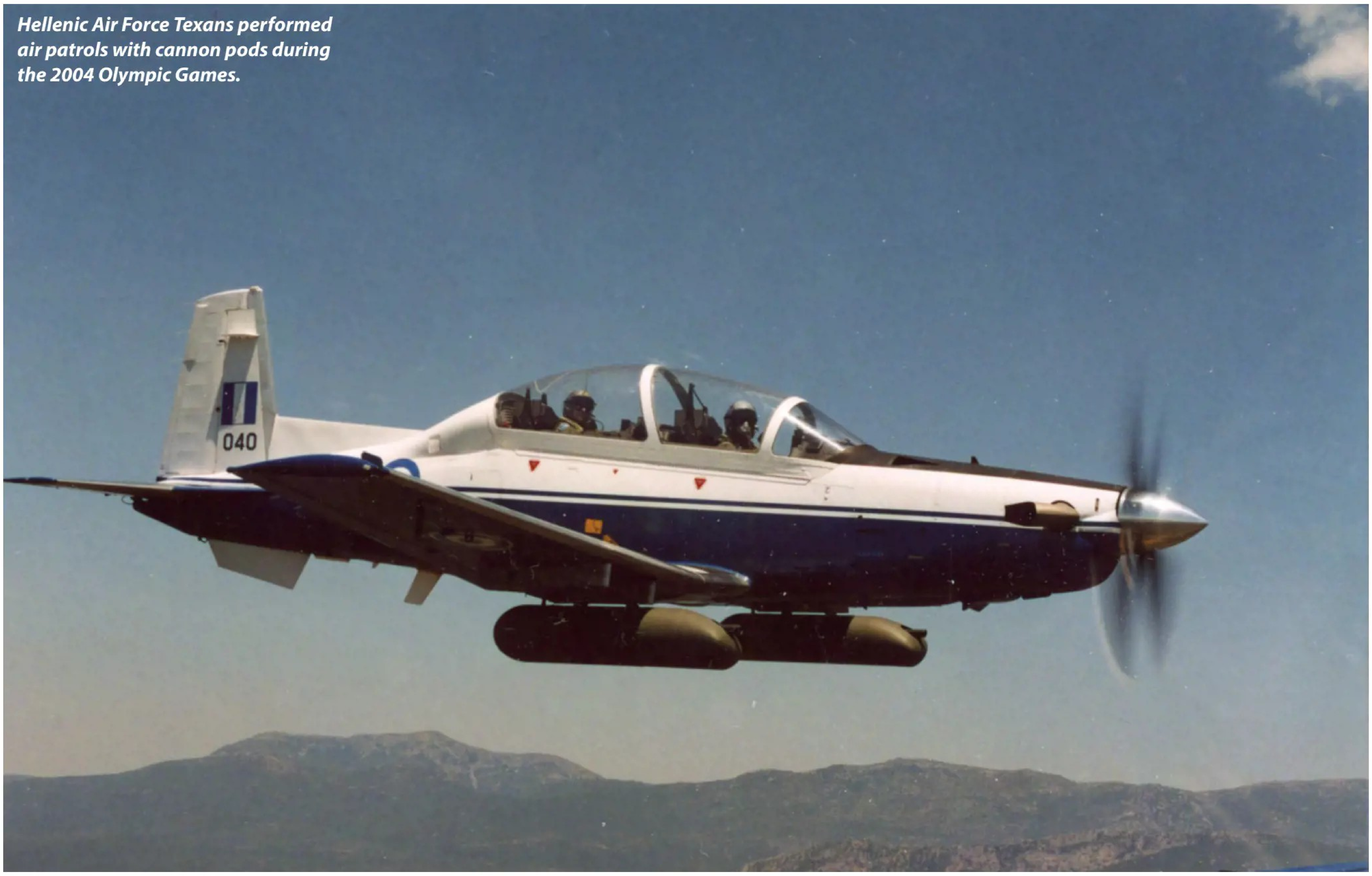
Illustrating the training path for a Naval Aviator is a T-6A from VT-10, a T-45C Goshawk of VT-86 and a F/A-18F Super Hornet of the 'Blue Angels' demonstration squadron, all based at NAS Pensacola. *Antonio More/USN*



RNZAF T-6Cs on the Ohakea flight line prior to a practice display by the Black Falcons team. *Jim Winchester*



The AT-6E Wolverine is Beech's light attack model of the Texan II, fitted with seven weapons pylons and various sensors. *Textron Defense*



Hellenic Air Force Texans performed air patrols with cannon pods during the 2004 Olympic Games.

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325
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A Texan T.1 of No. 72 Squadron and BBMF Spitfire IX. The two have a similar performance, although the Spitfire has a much better climb rate at full power.

Cpl Ed Wright RAF/Crown Copyright 2020

one screen showing flight instruments, one with engine instruments and the third with a navigational display.

Beech markets a light attack version as the AT-6E Wolverine. They describe it as having the A-10C's mission computer and the F-16's Hands-on Throttle and Stick (HoTaS), controls. The sensor suite is adapted from the MC-12W including an MX-15Di EO/IR turret. It also features a Helmet-Mounted Cueing System (HMCS), and a digital glass cockpit with three colour MFDs for integrated navigation, sensor, and weapon's management/ delivery. Weapons options include LGBs, laser-guided missiles and rockets and 0.50in or 20mm gun pods.

As part of the Light Attack Experiment (OA-X), the USAF purchased two Wolverines for evaluation alongside the Embraer Super Tucano. In the end the AT-802U Sky Warden was chosen and the AT-6Es were returned to Beech after having received military certification. A number of Wolverines have been built for export as AT-6s (no suffix) with various detail differences, but sharing seven weapons pylons, cockpit armour and a strengthened airframe.

Every T-6 sold generates a royalty for Pilatus, which is some compensation for when it beats the PC-7, PC-9 or PC-21 for an export order. So far 14 countries outside the US have bought the T-6 and AT-6. The main export version is the T-6C, which adds hardpoints for the carriage of external fuel tanks. The T-6C+ has provision for weapons, mainly for training purposes.

Argentina has 12 T-6C+ that were delivered from 2017. Canada's 26 aircraft are designated CT-156 Harvard IIs and differ in having an automatic direction finder, a second VOR, a propeller de-icing system, a standby VHF transceiver and an approach chart holder. They are operated under the Nato Flying Training in Canada (NFTC) programme by CAE at CFB Moose Jaw. Colombia has eight T-6Cs with 16 more on order; Greece bought 45, the final 20 of which are built to New Trainer Aircraft standard with a weapons sight and the ability to carry underwing stores.

The 15 Iraqi aircraft were delivered from 2009 and Israel's 20 are called the Efroni (Lark). Mexico is one of the largest users with 55 T-6C+ serving in the Air Force and another 15 with the Navy

Morocco was the launch customer for the T-6C and 24 serve with two training squadrons at Marrakech. New Zealand's 11 T-6Cs fly with 14 Squadron and the Central Flying School at Ohakea. The CFS provides the pilots for the 'Black Falcons' formation aerobatic team.

Thailand has 12 T-6THs and two AT-6THs with six more of the latter on order. Tunisia has eight T-6Cs, with four more and four AT-6Cs ordered for delivery in

Vietnam has received six T-6C+ in two batches, delivered in 2024 and 2025. The Royal Air Force operates 14 Texan T.1s at RAF Valley through a contract with Affinity as part of the Military Flying Training System.

In 2025 some 975 T-6s and AT-6s are in service, with an order book taking the total over 1,000. The most recent customer is Japan, which has selected the Texan for its T-7 replacement, ordering 36 T-6Cs in January 2025. ■

Beechcraft T-6A Texan II

Crew: Two
Length: 33ft 3in (10.14m)
Wingspan: 32ft 3in (10.13m)
Height: 10ft 9in (3.26m)
Empty weight: 4,600lb (2,087kg)
Max T/O weight: 6,300 lb (2,857 kg)
Powerplant: One Pratt & Whitney PT-6A-68 turboprop engine derated to 1,100 shp (821kW)
Max speed: 448mph (721km/h)
Service ceiling: 35,000ft (10,668m)
Range: 1,056 miles (1,700 km)
Armament: None

The Grob 120TP Prefect replaced the Tutor T.1 in the elementary flying training role with No. 57 Sqn and No. 703 Naval Air Squadron at RAF College Cranwell. Unlike the Tutors, the Prefects are on the UK military register. LPhot Sam Seeley/Crown Copyright 2022

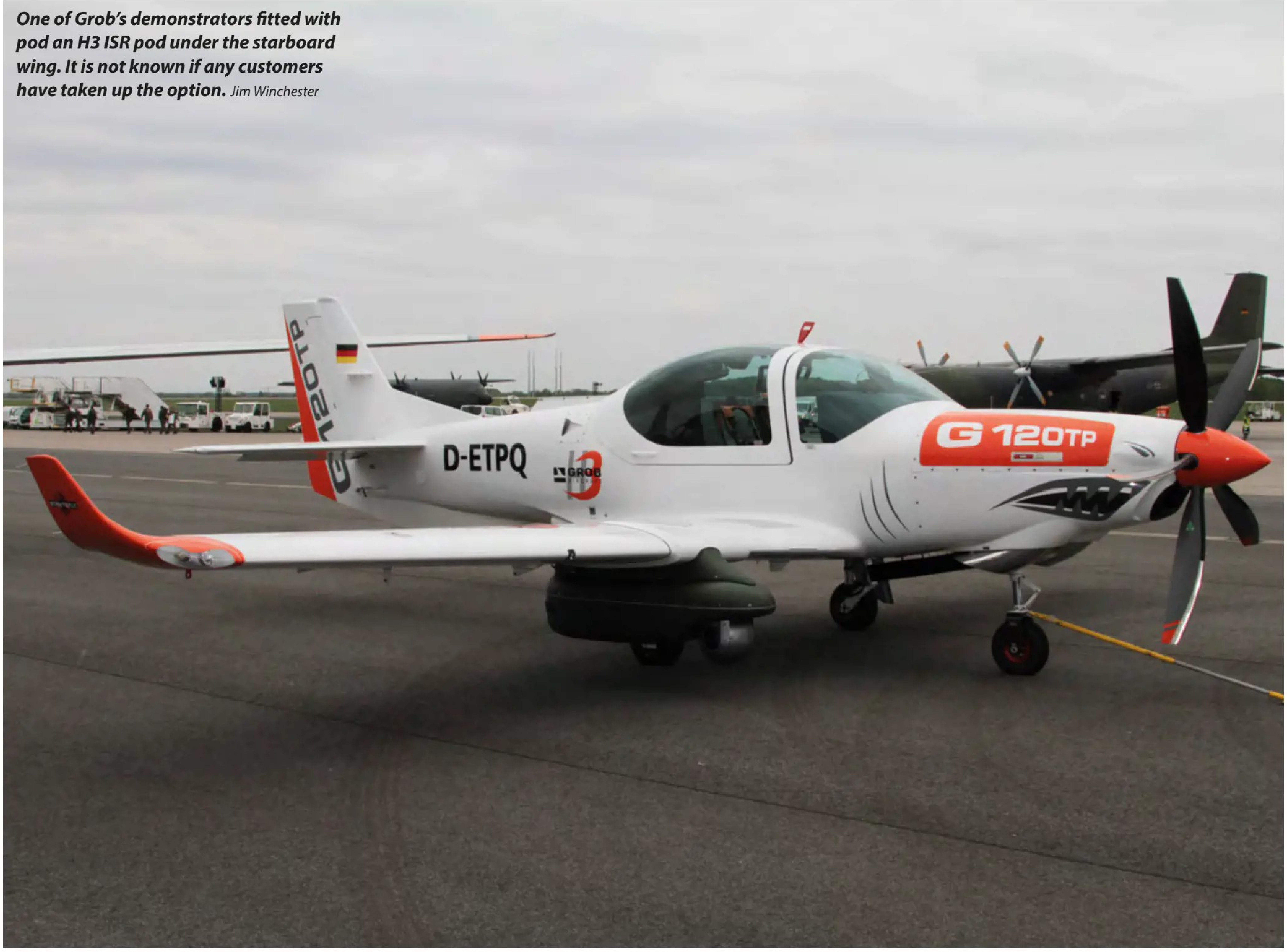
Grob 120

Digital Trainer

The Grob 120A is in service in Canada as the CT-102A Astra I, although is soon to be replaced by the CT-102B Astra II or G120TP in the primary training role. Cpl Vicky Lefrancois/RCAF

Adding a retractable undercarriage and later a turboprop engine as well as a glass cockpit, the Grob 120 built on the relative success of the G115 to create a more sophisticated primary trainer more suitable for preparing pilots to fly advanced types.

The prototype Grob 120A, D-ELHU, with retractable undercarriage and a 260hp (190kW) Lycoming AEIO-540-D4D5 flat-six piston engine first flew, unannounced, in 1999. The first examples were sold to Lufthansa's US-based flying school with Israel being the first military customer, dubbing their aircraft the Snunit (Swallow). Like many air arms since the 1990s, the IDF/AF has contracted its primary flight training to private companies, in this case Snunit Aviation. Under a public-private finance deal, the G120A was acquired for Canada as the CT-102A Astra. The provider is the Allied Wings consortium led by Kelowna Flightcraft (KF), which has based



One of Grob's demonstrators fitted with pod an H3 ISR pod under the starboard wing. It is not known if any customers have taken up the option. *Jim Winchester*

the aircraft at Southport, Manitoba since 2006. Primary training for France's Armée de l'Air is conducted on 18 G120As with the Airbus Flight Academy at Champniers.

In March 2010 the G 120TP followed. It was derived from the 120A but with a Rolls-Royce M250-B17F turboprop engine and a five-bladed propeller. Like the G115, the G120TP is of all-composite construction. It is 50kts faster and is aerobatics capable, stressed to +6 and -4g. The cockpit has an Electronic Flight Instrumentation System (EFIS) with a four-screen MFD instrument panel layout. The controls are similar to frontline military aircraft including a Hands on Throttle and Stick (HoTaS) interface. The avionics and displays eliminate the need for students to learn glass cockpit flying later in their training.

Customers for the G120TP to date include: Argentina (eight); Bangladesh (24); Canada, (23); Ecuador (eight); Ethiopia (12); Indonesia (30); Jordan (14); Kenya 11); Mexico (25); Myanmar (20); Sweden (ten); the United Kingdom (23) and US Army (six).

Sweden's aircraft are designated SK40. They were ordered in 2021 and the pilots graduated from the Air Force Flight School in Linköping in August 2025. The US Army operates six G120TPs via CAE USA, the first of which was handed over at Dothan, Alabama in 2017 for its Fixed-Wing Flight Training programme. Under Canada's Future Aircrew Training (FAcT) programme, SkyAlyne, a partnership of KF and CAE, will supply 23 CT-102B Astra IIs to be based at Moose Jaw, Saskatchewan.

The RAF operates 23 G 120TPs as the Prefect T.1 for elementary flight training, replacing the Tutor in that role. The aircraft are flown by No. 57 Squadron as part of No.3 Flying Training School based at RAF College Cranwell. The aircraft are provided by Affinity Flight Training Systems on behalf of Ascent as part of the UK Military Flying Training System (MFTS), a 25-year Private Finance Initiative (PFI) deal provided by Lockheed Martin and Babcock.

Underwing hardpoints allow carriage of equipment such as intelligence, surveillance and reconnaissance (ISR) pods. Grob has displayed company demonstrators with a pod designed by former owners H3 Aerospace. This is designed to quickly turn a trainer into a light ISR platform with a removable pod under one wing and a compact control station in the cockpit. ■

Grob 120TP-A

Crew: Two
Length: 27ft 8in (8.42m)
Wingspan: 33ft 10in (10.31m)
Height: 8ft 8in (2.64m)
Empty weight: 2,469m (1,120kg)
Max T/O weight: 3,174lb (1,440kg)
Powerplant: One Rolls-Royce M250-B17F turboprop engine rated at 456shp (340kW)
Max speed: 270mph (435km/h)
Service ceiling: 25,000ft (7,620m)
Range: 834 miles (1,324km)
Armament: None

The Brazilian aerobatic team known as the Smoke Squadron flies the single-seat A-29A Super Tucano. Johnson Barros/FAB

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A-29A

Embraer EMB-314 Super Tucano

Angrier Bird

Building on the success of the EMB-312 Tucano, Embraer reworked the design to create a much more capable light attack and ISR aircraft, which has had comparable international sales and combat use.

The Tucano was facing increasing competition from the Pilatus PC-9, which was being progressively modernised and selling around the world as a basic trainer. Most of its sales had come in a relatively short period and orders were drying up. To meet the USAF and USN's Joint Primary Air Training System (JPATS) requirement, which promised to be a huge contract, Embraer modified PT-ZTW as a proof of concept aircraft, designated EMB-312H. Changes included stretching the rear fuselage by 4ft 4in (1.31m) and fitting a ventral airbrake. Installing a PT6A-67R engine gave more than twice the power of the standard EMB-312. In its revised form, PT-ZTW flew on 9 September 1991, with test pilot Gilberto Predrosa Schittini and flight test engineer Mauro César Mezzacappa in the cockpit.

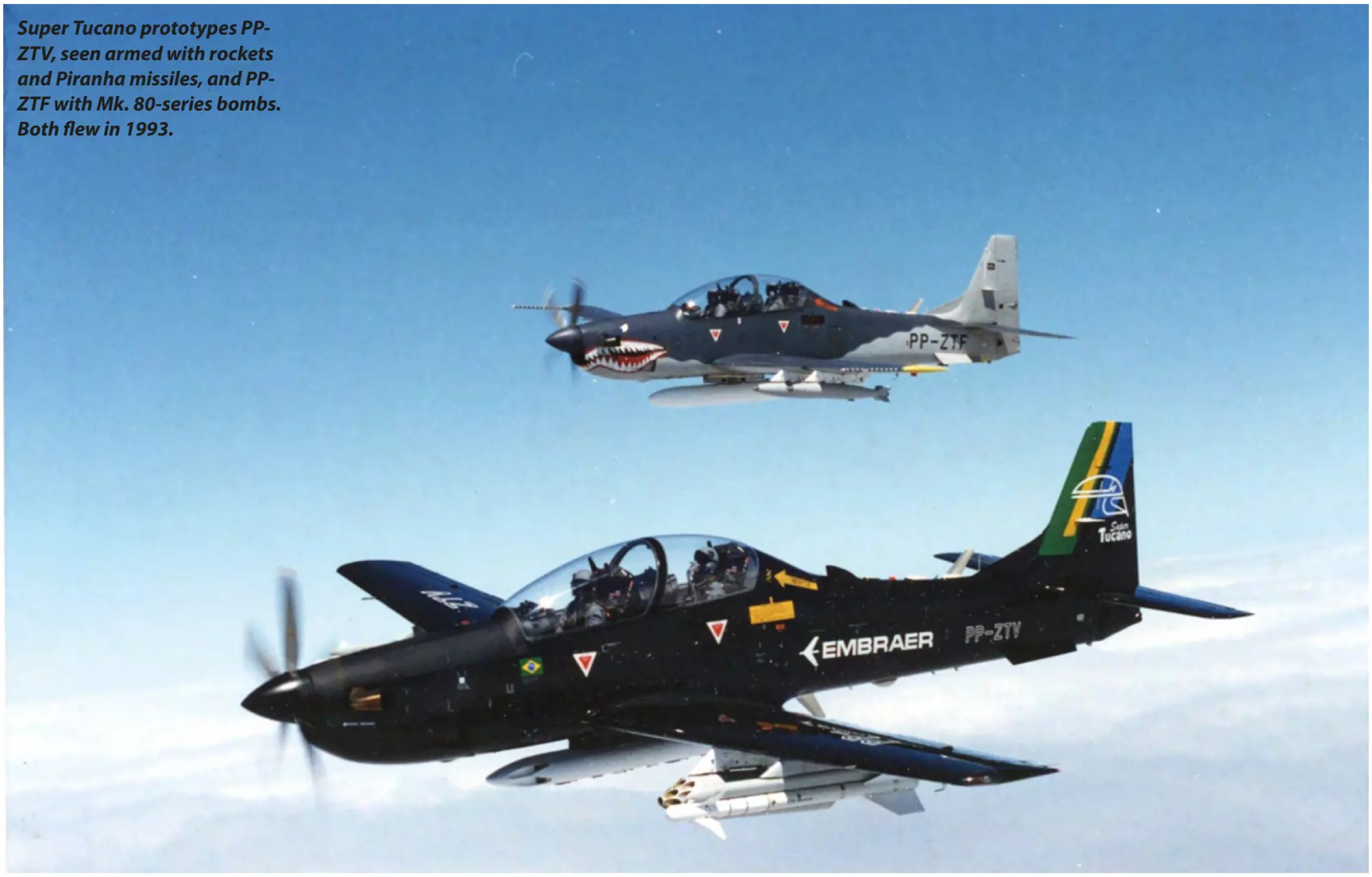
After negotiations with General Dynamics and Lockheed Martin failed, Embraer chose Northrop as its US partner for the JPATS competition and under their guidance modified the EMB-312H further, with a new vertically opening canopy, new display screens, GPS and TCAS.

In 1995 Beechcraft's T-6, based on the PC-9 was chosen for JPATS. The Super Tucano was selected as part of the Nato Flying Training in Canada (NFTC) programme, but the order was cancelled by prime contractor Bombardier, which competed with Embraer in the regional airliner sector.

Facing lean times, Embraer's military business was saved by the decision to arm the Super Tucano and market it as a light attack aircraft, known as ALX. The Brazilian Air Force (FAB) saw the potential as part of the Amazon surveillance system and as a combat trainer. It would allow the modernisation of the FAB to move forward, introducing some of the technology found in contemporary jet fighters which would soon be required in Brazil. A contract for 148 production EMB-314 Super Tucanos was signed in August 1995.

The EMB-314 was based on the JPATS contender but now further altered with a side-opening bird-resistant canopy incorporating a central frame, a pressurised cockpit, HoTaS controls and an anti-g system. A central mission computer processed data from colour MFDs, the HUD and the Engine Indicating and Crew Alerting System (EICAS). There was provision for a FLIR turret, which would be operated by the back-seater.

Weapons were integrated in the airframe in the form of two FN Herstal 12.7mm machine-guns mounted in the wing. The gun and ammunition layout were reportedly influenced by study of the Curtiss P-40 in the national aerospace museum. The FAB planned to order 50 single-seat A-29As, but soon realised the pilot could not efficiently operate the sensors and fly at the same time, and reduced the number to 33, alongside 66 A-29Bs. The A-29A



Super Tucano prototypes PP-ZTV, seen armed with rockets and Piranha missiles, and PP-ZTF with Mk. 80-series bombs. Both flew in 1993.

retains the same canopy, but the rear seat position is occupied by a 110 US gal (400 litre) fuel tank. Since the so-called 'Shoot-down Law' was enacted in 2004 the FAB has fired upon numerous light aircraft suspected of smuggling. Most of these have been warning shots, but several aircraft have crash-landed in the Amazon region after hits from an A-29's machine-guns. Clandestine airfields have been attacked by day and night with BAFG unguided bombs, denying their use to smugglers.

Brazil's aircraft operate with three squadrons of the 3rd Aviation Group: 1°/3°GAv at Boa Vista; 2°/3°GAv at Porto Velho and 3°/3°GAv at Campo Grande, and one of the 5th Aviation Group at the Air Force Academy, known as 'Joker Squadron', which teaches fighter tactics.

The Super Tucano took over from the EMB-312 Tucano with the Esquadrilha da Fumaça ('Smoke Squadron') aerobatic team from 2012. The team's aircraft have no HF radios and gun armament and ammunition is replaced by smoke generators and oil tanks.

Super Tucanos have sold well abroad and new orders continue to arrive, both from existing Tucano operators and new customers.

As part of the Light Air Support programme (LAS), Afghanistan received 26 A-29Bs, supplied by the USAF and assembled and equipped by Sierra Nevada Corporation (SNC). The first were delivered to the Kabul Air Wing in January 2016. They were also later issued to the Strike Squadrons of the Kandahar and Mazar-e-Sharif Air Wings. The A-29Bs provided the Afghan National Army Air Corps (ANAC) with its first fixed-wing combat aircraft. They were soon in action, providing close air support to troops fighting Taliban forces with guns, rockets, conventional bombs and GBU-12 laser-guided bombs. These were employed with the help of BRITE Star II laser designators. In 2021 after the fall of Kabul, the country's air arm was renamed the Islamic Emirate of Afghanistan Air Force. A number of A-29Bs flew to neighbouring countries but one was reportedly shot down in Uzbekistan. Although the rest fell into Taliban hands, only a single A-29B may remain active.

As part of fighter pilot training, a Super Tucano of Brazil's 'Joker Squadron' drops a pair of BAFG-120 bombs on a training range at Natal. FAB

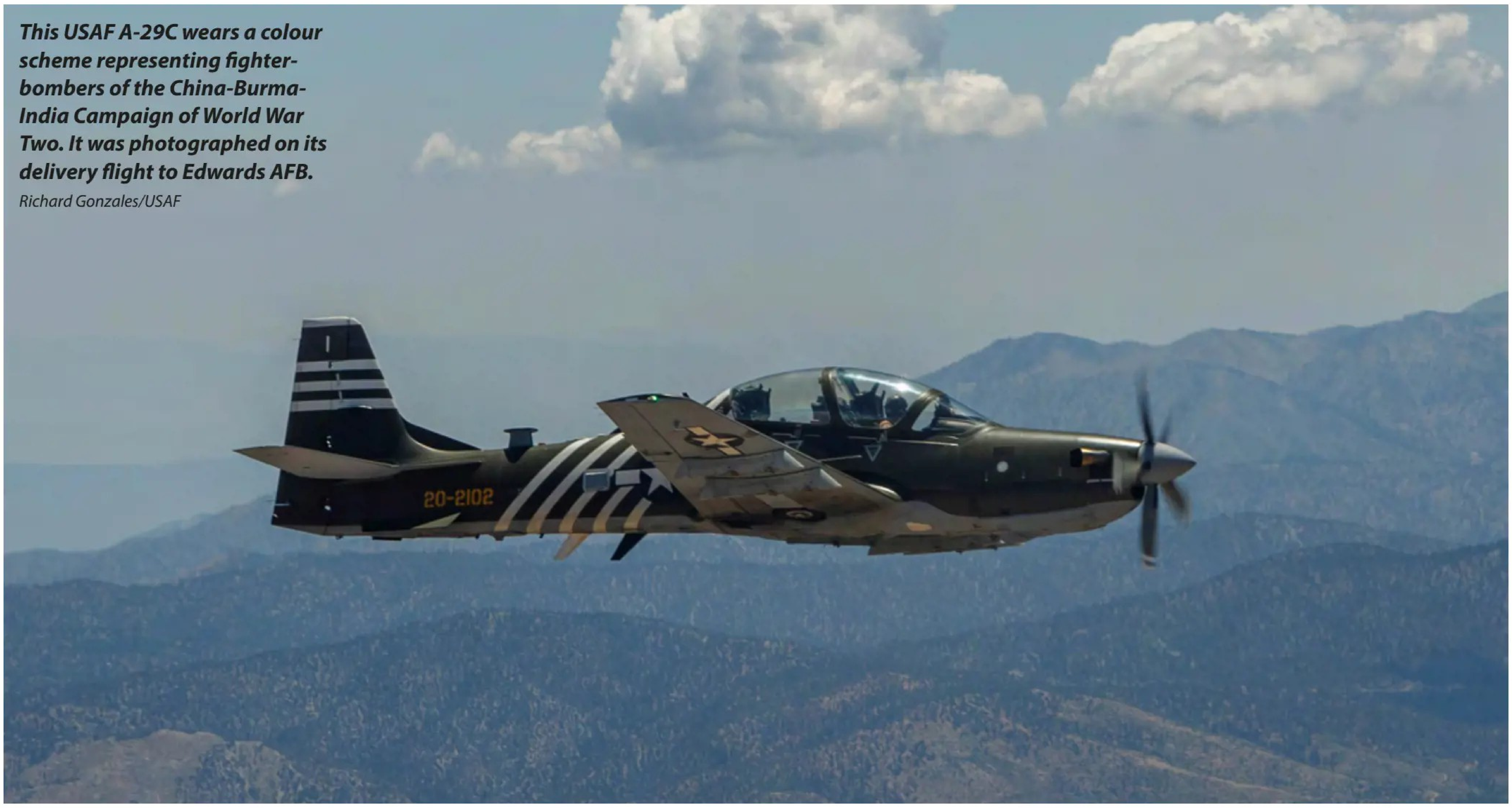
A pair of armed Afghan A-29Bs flies on a training mission over Afghanistan in March 2017. *Tech. Sgt. Jordan Castelan/USAF*

Angola's National Air Force is a repeat Embraer customer, signing for 12 EMB-314s in 2012 for use as pilot trainers and a variety of operational tasks including interception, reconnaissance and close air support. They serve with 16 Esquadra de Caça-Bombardeiros at Catumbela. Burkina Faso received its three aircraft in 2011 and they are based at Bobo Dioulasso with Escadron E-16, although are reportedly flown infrequently. Chile's first 12 aircraft, delivered in 2009, are used to train prospective F-16 pilots and incorporate a synthetic training package incorporating virtual radar. Further deliveries have brought the current fleet up to 22, with newer aircraft operated in the light attack role with Grupo de Aviación Nº1 at Iquique.

Colombia updated its light attack fleet with the purchase of 25 A-29Bs in 2005. These were compatible with Israeli Lizard and Griffon guided bombs and had chaff/flare launches and, self-sealing fuel tanks and side armour plates. With precision weapons the FAC Super Tucanos could deliver strikes from safe altitudes where their approach could not be seen or heard. A night attack in September 2007 destroyed a FARC bunker, killing a much-wanted guerrilla leader and drug trafficker. In other operations, bombs were released in Colombian airspace, hitting camps in Ecuadorian territory. At least five smuggling aircraft have been shot down by Colombian A-29s. Other missions include the detection and photography of illegal gold mining operations. Today they serve with Escuadrón de Combate 211 at Apiay, EC 301 at Yopal, EC 312 at Barranquilla and EC 611 at Tres Esquinas as well as Escuadrón de Combate Táctico 713 at Calí, although are often detached to remote locations.

The Dominican Republic's A-29Bs are based at San Isidro where P-51D Mustangs served until the 1980s. The Super Tucano's are the FAD's only current combat aircraft. *Lt. Col. Justin Brockhoff/USAF*

BIENVENIDO A LA BASE AEREA SAN ISIDRO
FUERZA AEREA DOMINICANA



This USAF A-29C wears a colour scheme representing fighter-bombers of the China-Burma-India Campaign of World War Two. It was photographed on its delivery flight to Edwards AFB.

Richard Gonzales/USAF

The Dominican Republic's eight A-29Bs, based at San Isidro with the Escuadrón de Combate have greatly reduced drugs transhipments through the nation's airspace and waters since 2009 by intercepting and tracking suspect light aircraft and boats. Many smugglers have been arrested and tons of narcotics recovered without having to shoot down or blow up a single one.

Ecuador's 18 EMB-314s joined the FAE in 2010-11 and are used for both training and combat tasks from Manta and Lago Agrio with Escuadrón de Combate 2312.

Indonesia became the first Asian operator accepting its 16 A-29As from August 2014. They are based at Malang with Skadron Udara 21 but also fly patrols from remote airfields. Lebanon's six A-29s were assembled in the US by SNC and delivered to 7 Squadron at Hamat in late 2017. They can be armed with LGBs and APKWS guided rockets. Mali, with four A-29Bs in the Escadrille de Chasse at Bamako-Senou and Mauritania with five at Atar with the Escadrille A-29 have used the Super Tucano against Islamic insurgents and smugglers across their vast deserts. Guns and rockets have proved useful against groups in lightly armoured or unarmored vehicles,

Nigeria took delivery of six for the Basic Flying Training Wing at Kano in 2021 amidst human rights concerns about their use against Biafrans and cattle rustlers as well as more threatening groups such as Boko Haram.

Existing EMB-312 user Paraguay ordered six EMB-314Es, which were delivered in mid-2025 to 3er Escuadron de Caza at Silvio Pettirossi. The Philippines also signed for six A-29Bs in 2017, assigning them to 16 Attack Squadron at Cavite. A further six were ordered in January 2025. Having retired its A-37s and IA-58 Pucaras, Uruguay is without a fixed-wing combat aircraft, but ordered six A-29Bs in July 2024. Panama has become the latest customer, confirming a deal for five A-29Bs in April 2025. These will become the country's first ever combat aircraft, used for anti-smuggling and fisheries patrol as well as training.

A new 'Nato-standard' Super Tucano version, the A-29N, has Nato-compatible avionics and a datalink. Although it might be thought that a propeller-driven attack aircraft would not last long in a high-intensity conflict and so of little value to most Nato nations, the A-29N is more aimed at training and duties such as peacetime interception of slow-flying aircraft and tracking of small boats. The launch customer is Portugal, which ordered 12 in December 2024 with the first three being delivered eight months later. The Portuguese Air Force plans to use them for pilot training with Esquadra 103, and for JTAC training and light attack if needed.

Having rejected the EMB-312H for JPATS in the 1990s, the US took another look in 2009 for the Air Force's Light Attack/Armed Reconnaissance (LAAR) requirement for approximately 100 aircraft. This effort fell prey to budget cuts. In 2017 the A-29C was evaluated for the Light Attack Experiment (OA-X) programme, but this too was cancelled. The 81st FS at Moody AFB, Georgia acquired three aircraft from SNC for training Afghan and Nigerian crews under the Combat Aviation Advisor (CAA) mission. In 2024 two were passed on to the USAF Test Pilots School at Edwards AFB, becoming the first new type in the school's inventory for nearly 30 years.

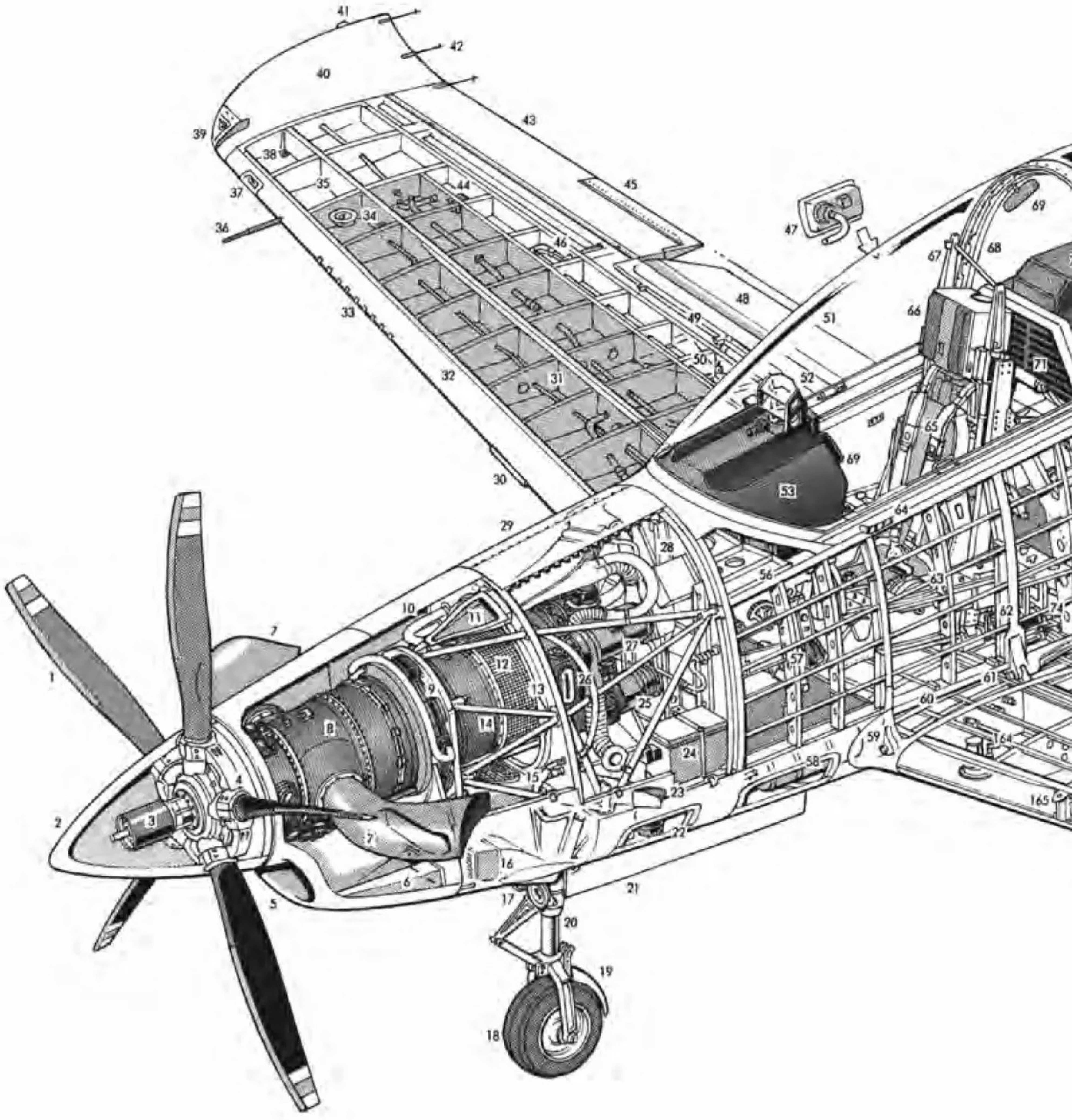
With drones playing an ever-increasing part in warfare, Embraer plans to expand Super Tucano capabilities to counter Unmanned Aerial Systems (UASs). This will include new datalinks for receiving initial target coordinates and cueing, an EO/IR sensor for laser tracking and designation for laser-guided rockets.. ■

Embraer EMB-314 Super Tucano

Crew: Two
Length: 37ft 3in (11.34m)
Wingspan: 36ft 6in (11.13m)
Height: 13ft 0in (3.97m)
Empty weight: 6,856lb (3,110kg)
Max T/O weight: 8,818lb (4,000kg)
Powerplant: One Pratt & Whitney Canada PT6A-68C turboprop engine rated at 1,600shp (1,194kW)
Max speed: 368mph (592km/h)
Service ceiling: 35,000ft (10,668m)
Range:
Armament: Two FN Herstal M3P 0.5in machine-guns with 250 rounds each; up to 3,417lb (1,550kg) ordnance on five hardpoints, including 70mm rockets, bombs up to 750lb (340kg), gun pods and MAA-1 Piranha AAMs

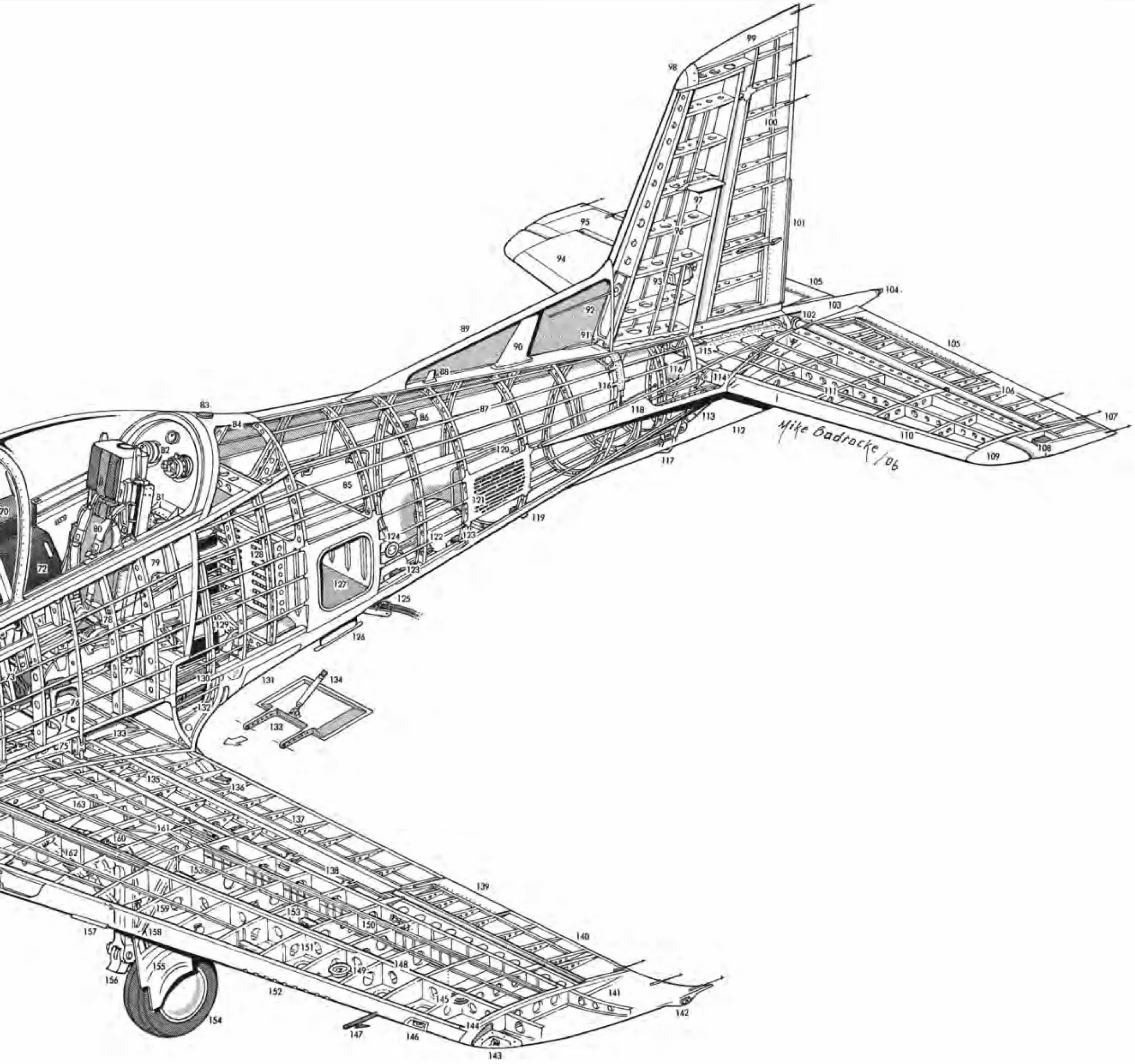
Pilatus PC-21

1 Hartzell five-bladed constant-speed propeller, graphite epoxy
2 Propeller spinner
3 Propeller hub pitch-change mechanism
4 Feathering counterweights
5 Engine air intake
6 Ventral oil cooler air intake
7 Exhaust stubs
8 Pratt & Whitney PT6A-68B turboprop engine
9 Main engine mountings
10 Carbon-fibre composite (CFC) engine cowlings
11 Equipment cooling air intake
12 Engine air intake filter scheme
13 Firewall
14 Engine bearer struts
15 Ice/particle separator intake duct
16 Ventral oil cooler
17 Landing/taxying lights
18 Aft retracting nose wheel
19 Fixed mudguard
20 Nose wheel shock absorber leg strut
21 Nose wheel doors
22 Engine-driven fuel pump
23 Intake ice/particle spill door
24 Battery, air conditioning pack on starboard side
25 Conditioned air system water separator
26 Engine oil tank
27 Generator
28 Cockpit front pressure bulkhead
29 Hinged equipment bay access hatches, port and starboard
30 Wing leading-edge stall buffet strip
31 Starboard wing integral fuel tank, total system capacity 148 Imp gal (675 litres)
32 Glass-fibre leading edge
33 Vortex generators
34 Overwing fuel filter
35 Wing tank vent compartment
36 Pitot head
37 Recognition light
38 Wing tip tie-down fitting
39 Starboard navigation light
40 CFC wingtip fairing
41 Strobe light
42 Static dischargers
43 Starboard aileron
44 Ventral temperature sensor
45 Aileron trim tab
46 Aileron hinge control linkage
47 Pressure refuelling connector mounted behind starboard trailing-edge fairing
48 Starboard slotted flap, extended
49 Starboard roll-control spoiler panel, CFC
50 Flap external hinge
51 One-piece cockpit canopy, hinged to starboard
52 Head-up display (HUD)
53 Front instrument console
54 Primary flight display
55 Dual multi-function displays
56 Forward fuselage/cockpit section upper main longeron
57 Rudder pedals and control column
58 ‘Aerobatic’ (inverted flight) fuel system accumulator
59 Wing front spar attachment
60 Fuselage bottom main longeron
61 Wing main spar attachment joint
62 Spar attachment mainframe
63 Cockpit side console panel and engine throttle lever
64 Canopy external handle
65 Student pilot’s Martin-Baker CH16C zero-zero ejection seat
66 Ejection seat headrest
67 Canopy breaker struts
68 Canopy centre arch and blast screen
69 Rear-view mirrors
70 HUD repeater
71 Canopy hinge damper strut
72 Rear instrument panel
73 Rear cockpit rudder pedals and control column
74 Aileron servo unit and flap hydraulic jack
75 Wing rear spar attachment joint
76 Kick-in boarding step
77 Cockpit section frame and stringer structure
78 Rear cockpit side console and engine throttle lever
79 Cockpit rear pressure bulkhead
80 Pilot’s Martin-Baker ejection seat
81 Ejection seat rails
82 Cockpit pressure control and relief valves



83 GPS antenna
84 CFC canopy aft fairing
85 Starboard side aft fuselage access hatch
86 Emergency locator transmitter (ELT)
87 Aft fuselage frame and stringer structure
88 ATC antenna
89 Glassfibre fin root fairing
90 V/UHF antenna
91 Fin spar root attachment point
92 ELT antenna
93 Rudder trim actuator
94 Starboard tailplane
95 Starboard elevator
96 Two-spar and rib fin torsion box structure
97 VOR/ILS antenna
98 Rudder horn balance
99 CFC tip fairing

100 Rudder rib structure
101 Rudder trim tab
102 Elevator hinge control
103 CFC tail fairing
104 Tail navigation light
105 Elevator trim tabs
106 Port elevator rib structure
107 Static dischargers
108 Elevator horn balance
109 CFC tip fairing
110 Tailplane glass-fibre leading edge
111 Two-spar and rib tailplane torsion box structure
112 Ventral fin, CFC
113 Tailplane rear spar support strut
114 Tailplane front spar attachment joint
115 Rudder hinge control, cable operated
116 Fin spar mounting sloping bulkheads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117 Aft tie-down fitting
118 Tailplane root fairing, glass-fibre
119 Lower ATC antenna
120 Vapour cycle cooling system condenser
121 Condenser intake grille
122 Exhaust fan
123 Dual radar altimeter antennas
124 Static port
125 Ground power socket
126 Lower V/UHF antenna
127 Baggage compartment, door omitted for clarity
128 Circuit breaker panel
129 Avionics equipment rack
130 On-board oxygen generation system
131 Port side wing root access hatch
132 Wing root trailing-edge fairing and boarding step housing
133 Ventral airbrake panel
134 Airbrake hydraulic jack
135 Flap shroud ribs
136 Hydraulically operated boarding step, linked to undercarriage operation
137 Port flap rib structure
138 Port roll-control spoiler panel
139 Aileron tab
140 Port aileron rib structure
141 Port CFC wing tip fairing
142 Strobe light
143 Port navigation light
144 Glare shield
145 Magnetometer
146 Port recognition light
147 Angle-of-attack transmitter
148 Three spar and rib wing panel torsion box structure
149 Port wing tank fuel filler
150 False spar/fuel tank rear bulkhead
151 Wing rib structure
152 Vortex generators
153 Built-in external stores hardpoints
154 Port main wheel
155 Main wheel leg door
156 Trailing axle main wheel suspension
157 Leading-edge stall buffet strip
158 Shock absorber strut
159 Forged main wheel leg
160 Hydraulic retraction jack
161 Main wheel leg pivot mounting
162 Side breaker strut
163 Main wheel bay
164 Fuel collector tank and immersed pump
165 Jacking point

The PC-21s of No. 4 Squadron RAAF are used for training JTACS, although the lack of a real weapons capability has led to dissatisfaction with the type in this role. *CPL Brett Sherriff/RAAF*

Pilatus PC-21

Hot Ship

The PC-21 is a high-performance, more refined follow-up to the PC-7/9 with fighter-like performance but only virtual weaponry. Its production is approaching that of the PC-9.

A programme for a 21st-Century trainer was launched by Pilatus in November 1998 as the PC-21. Test flights of a modified PC-7 Mk II (HB-HMS) with a swept-back fin, spoilers, a power management system and five-blade propeller began in late 2000. This later received PC-21 avionics and mission management system. First flight of the actual PC-21 prototype (HB-HZA) was on 1 July 2002. The second development aircraft (HB-HZB) flew on 7 June 2004 but was lost in a crash in January 2005 while performing aerobatics. The first production aircraft flew in August 2005.

As part of a full training system, the PC-21 embedded simulation and mission planning/debriefing software and is integrated ground-based training environment. The PC-21 is optimised for advanced pilot and weapons

A Swiss PC-21 makes an inverted flypast at the Axalp firing range in October 2012. *Jim Winchester*

A PC-21 destined for the Spanish Air Force on a test flight over the Swiss Alps.

Pilatus

systems officer training at turboprop costs, allowing users to streamline. aircrew transition to a frontline type. The concept is to download several phases of training to one platform. Instead of an elementary piston trainer aircraft, a basic training turboprop, an advanced training light jet and a lead-in fighter training jet, the PC-21 can cover all these stages, assisted by simulators, especially at the first phase. This is said to reduce the cost by as much as 50 per cent up to the wings graduation point.

Underwing stores pylons can be carried, but most weapons training is carried out virtually using software to simulate weapons aiming, release and parameters. A greater load of virtual 'weapons' can be carried than the aircraft's actual carrying capacity. As many as eight PC-21s can be linked with Mode S datalinks for air combat manoeuvring (ACM) training. The pilots have three multifunction displays (MFDs) and an up-front control panel (UFCP) in both cockpits, with hands on throttle and stick (HOTAS) controls.

The wing has 12-degree sweepback at the leading-edge and features spoilers for enhanced roll control, giving roll rates up to 200 degrees/sec. The PC-21 is capable of sustained low-level speeds in excess of 320kts (593km/h) and the leading-edge has impact-absorbent material for birdstrike resistance. The airframe itself is stressed to loads between +8 and -4g. The PT6A-68B turboprop drives a Hartzell five-bladed 'scimitar' graphite/titanium propeller. Pilot and back-seater sit on Martin-Baker Mk 16L zero-zero ejection seats in a pressurised cockpit. The rear seat is raised up higher than that of the PC-7, giving improved forward vision. The two-section acrylic canopy has a thickened front for birdstrike resistance without requiring a separate windscreen.

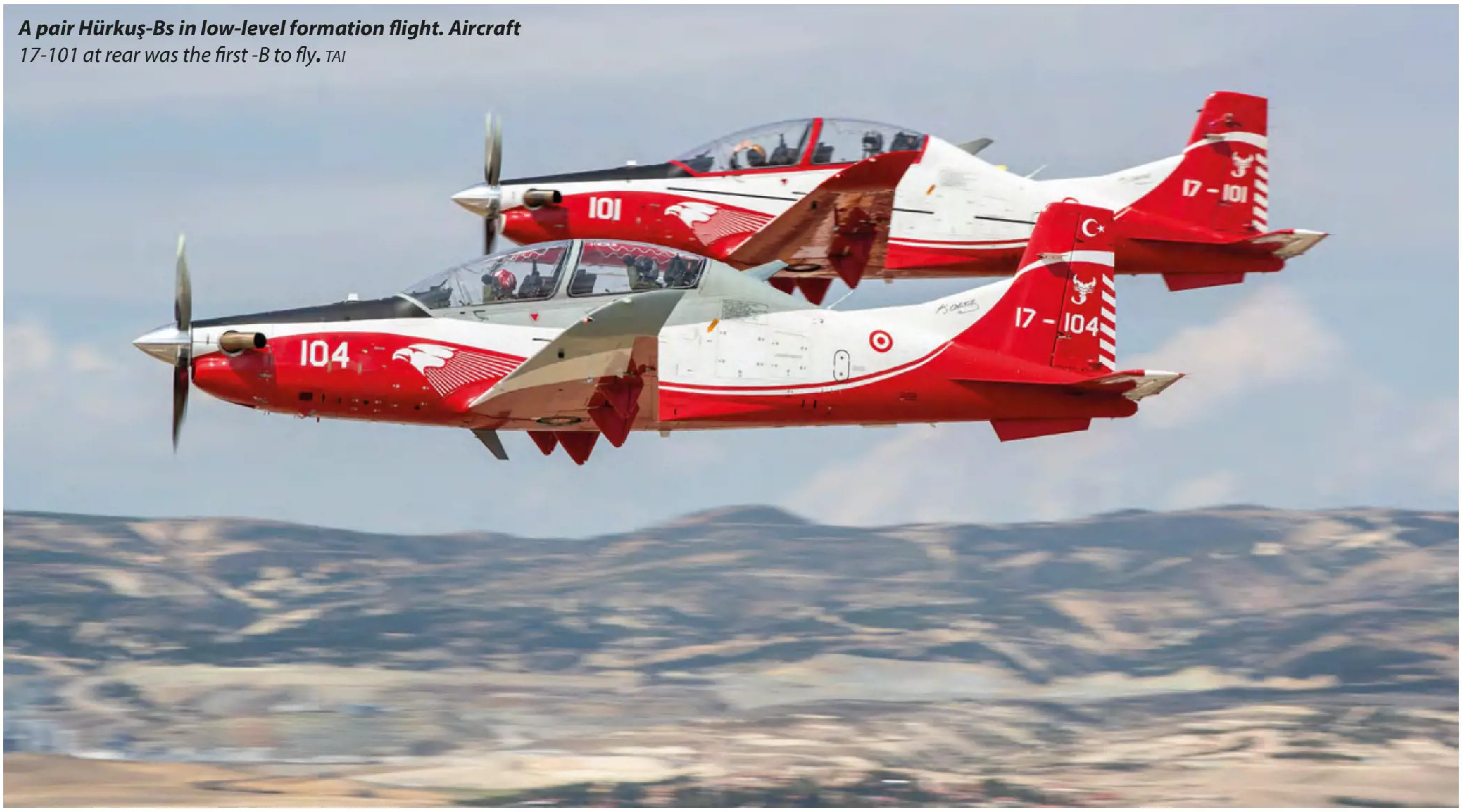
The first six PC-21s were supplied for the Swiss Air Force's Jetpiloten-Ausbildungssystem (jet pilot training system) in 2007 plus two more in 2012. These replaced the BAe Hawk in this role and are based at Sion. Export sales began relatively slowly, in part because of the high unit price. Singapore chose the PC-21 for its basic wings course in in 2006 under a 20-year contract with Lockheed Martin Simulation. Due to the small size and constrained airspace of Singapore, most of the RSAF's training is conducted overseas and the PC-21 fleet of 19 has been based at RAAF Pearce in Western Australia since 2008 with No. 130 Squadron. Team 21, consisting of Lockheed Martin, Hawker Pacific and Pilatus were also awarded the contract to run Australia's new pilot training system and the first of 49 were handed over to the RAAF in March 2017. The PC-21s are based at Pearce, with No. 2 FTS and East Sale, Victoria with No. 1 FTS and the Central Flying School. The CFS Roulettes team fly a six-aircraft PC-21 display with smoke generators. Forward Air Controller training is carried out by No. 4 Squadron at Williamtown, New South Wales with four aircraft, but the inability of the PC-21 to deploy live ordnance has caused the RAAF to seek a replacement aircraft that can.

In 2009 the United Arab Emirates Air Force & Air Defense Force signed for 25. The Royal Saudi Air Force (RSAF) contracted for 55 PC-21s in 2012 and an order for 25 from the Qatar Emiri Air Force came the same year.

To date, two European operators other than Switzerland have acquired the PC-21 for pilot training. The Armeé de l'Air's 26 PC-21s are leased from Babcock France and have been based at Cognac since 2019. Spain is replacing the C101 Aviojet and the T-35 Pillán at the Academia General del Aire (AGA) in San Javier. The first of an initial 24 arrived in September 2021 with a further 16 ordered in 2023.Owned by Qinetiq, the Empire Test Pilot's School (ETPS) has two civil-registered PC-21s at Boscombe Down, Wiltshire for advanced training. Canadian contractor SkyAlyne has ordered 19 as part of the FAcT (Future Aircrew Training) programme. In service they will be known as the CT-157 Siskin II and will be stationed at RCAF Moose Jaw, Saskatchewan, from 2026. ■

Pilatus PC-21

Crew: Two
Length: 36ft 10in (11.23m)
Wingspan: 29ft 11in (9.11m)
Height: 6ft 7in (2.01m)
Empty weight: 5,026lb (2,280kg)
Max T/O weight: 7,936lb (3,600kg)
Powerplant: One Pratt & Whitney Canada PT6A-68B turboprop rated at 1,600shp (1,193kW)
Max speed: 426mph (685km/h)
Service ceiling: 38,000ft (11,580m)
Range: 828 miles (1,333km)
Armament: Provision for external stores on one centreline and four underwing hardpoints



A pair Hürkuş-Bs in low-level formation flight. Aircraft *17-101 at rear was the first -B to fly.* TAI

TAI Hürkuş

Turkish Pioneer

Türkiye's modern aerospace industry has seen rapid growth and makes sophisticated drones, helicopters, jet trainers and jet fighters, but it was kickstarted by the Hürkuş trainer and light combat aircraft.

Turkish Aerospace Industries (TAI or TUSAŞ) began design studies in 2006 under the Primary and Basic Trainer Aircraft Development Programme. The TT-32 Hürkuş – named after Turkish aviation pioneer Vecihi Hürkuş – emerged with a similar configuration to the PC-21. The primary structure was aluminium alloy with composites used for secondary structures such as engine cowlings and wingtips. The aerofoil was optimised to achieve low stalling speeds. The tried-and-true PT6A-68T engine drove a five-bladed Hartzell aluminium propeller. The rear of the pressurised cockpit is elevated and the crew have Martin-Baker T-16N zero/zero ejection seats.

First prototype Hürkuş TC-VCH flew on 29 August 2013 and the second (TC-VCI) on 10 September 2014. During testing the elevators and rudder were enlarged and small ventral fins and winglets added.

In June 2016 the Hürkuş-A basic trainer became the first Turkish aircraft to receive type certification from EASA, and meets civil standards for day/night flying and aerobatics with a 30-second inverted flight capability. The Hürkuş-A was developed in parallel with the advanced Hürkuş-B. This features integrated avionics by Aselsan, including HUD and MFD, a mission computer and INS/GPS navigation systems. The first -B flew in January 2018 and the initial examples were delivered to 122 Filo at İzmir-Çiğli by early January 2019.

The Hürkuş-C light attack version incorporates seven hardpoints for up to 3,307lb (1,500kg) of weapons or other stores. A ventral EO/IR turret allows surveillance and targeting by the sensor operator in the rear seat. TAI markets it as being suitable for border patrol and security, anti-narcotics operations, close air support, armed reconnaissance, aerial interdiction, surveillance and reconnaissance, forward airborne air control and escort missions.

The Turkish Air Force (TuAF) has 55 Hürkuş-2s on order, the Land Forces, 24 and Gendarmerie Aviation Command, six. There are six examples of a specialised forward air control variant, the Hava Yer Entegrasyon Uçagi (HYEU: Air to Ground Integration Aircraft) assigned to the TuAF's 135 Filo at Konya. TAI has proposed a variant for the Turkish Coast Guard capable of inshore maritime patrol missions.

A small number of aircraft have been exported to date, taken from Turkish orders and all delivered to African nations: Central African Republic (three -Cs); Chad (three -Cs); Niger (two -Bs); Libya is also said to have ordered an undisclosed number.

The Hürkuş-II has a composite structure which is lighter than the current -A and -B. It features a new canopy and wide-angle HUD. A prototype (TUS-A013) made its maiden flight on 30 December 2024. It competed for Japan's trainer requirement that was won by the Beech T-6C. ■

TAI Hürkuş-B

Crew: Two
Length: 36ft 8in (11.17m)
Wingspan: 35ft 10in (10.91m)
Height: 12ft 2in (3.70m)
Empty weight: 8,545lb (3,876kg)
Max T/O weight: 9,980lb (4,530kg)
Powerplant: One Pratt & Whitney Canada PT6A-68T turboprop engine rated at 1,600shp (1.193kW)
Max speed: 330mph (533km/h)
Service ceiling: 39,270ft (11,970m)
Range: 739 miles (1,190km)
Armament: 12.7mm gun pod, laser-guided Micro Munitions, training bombs, 250lb or 500lb bombs

NEXT ISSUE!

British Aircraft of World War One

The aviators of what was called the Great War have been called the 'Knights of the Sky', officers fighting individual combats above a battlefield where millions of men struggled amidst mud, machine-guns and shellfire. The reality was somewhat less glamorous and the life expectancy of a Royal Flying Corps pilot could be measured in weeks. The constant see-sawing of aerial supremacy saw hand-held weapons from rifles and pistols and even bricks give way to multiple automatic weapons. The ace pilots were those who learned to sneak up on their opponent and shoot him in the back.

Nonetheless, there was still a degree of chivalry in the skies where the RFC fought, triumphed and emerged in 1918 as the independent Royal Air Force.

Aviation Archive Issue 84 presents the famous and lesser-known fighters, bombers and reconnaissance aircraft of the RFC and RAF 1914-18 through archive photographs, detailed cutaway drawings and colourful profile paintings.

Royal Aircraft Factory SE.5As prepare to take off on patrol.

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Kiwi Singapore's South Pacific war
JET ART AVIATION
20 years in business – but what's next?
SECRETS OF THE BLACK LAKE
Aircraft wreckage revealed amid the dramatic landscape of Snowdonia's Llyn Dulyn

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